A McGRAW-HILL PUBLICATION **NOVEMBER 1961**

ONE DOLLAR

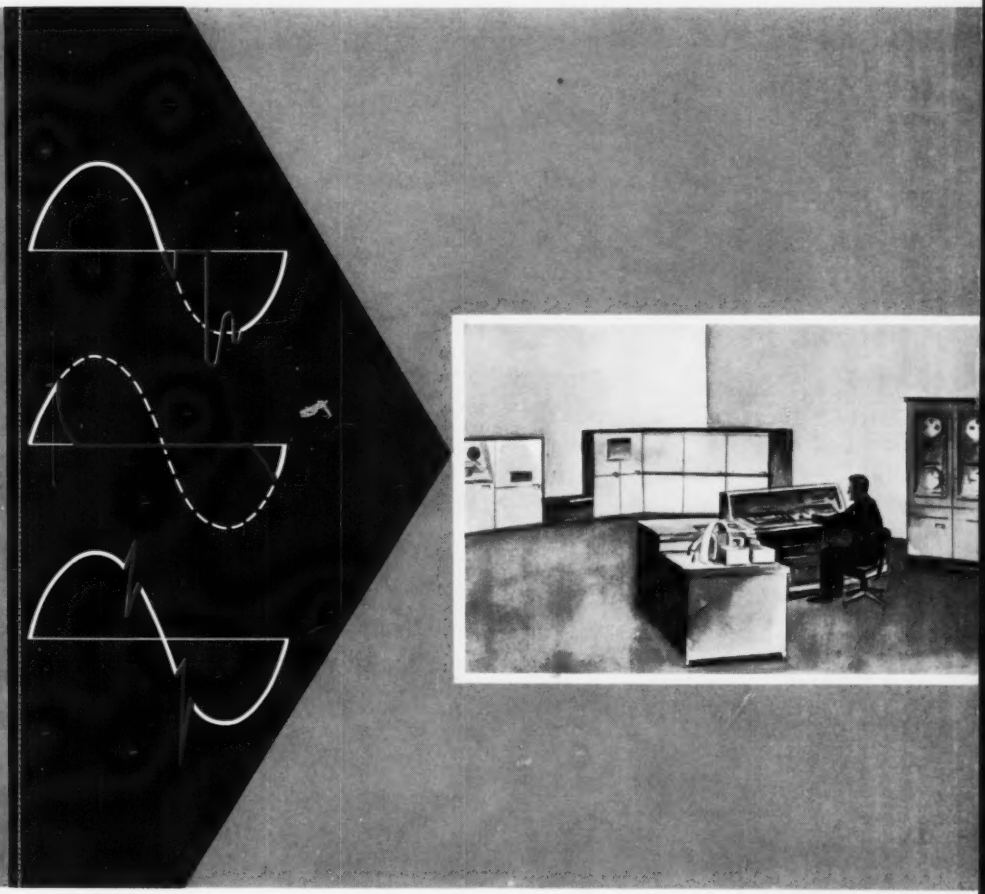
Power

the magazine of energy systems engineering

DATA PROCESSING SYSTEMS

How pure an electric supply?

a TD report • 57



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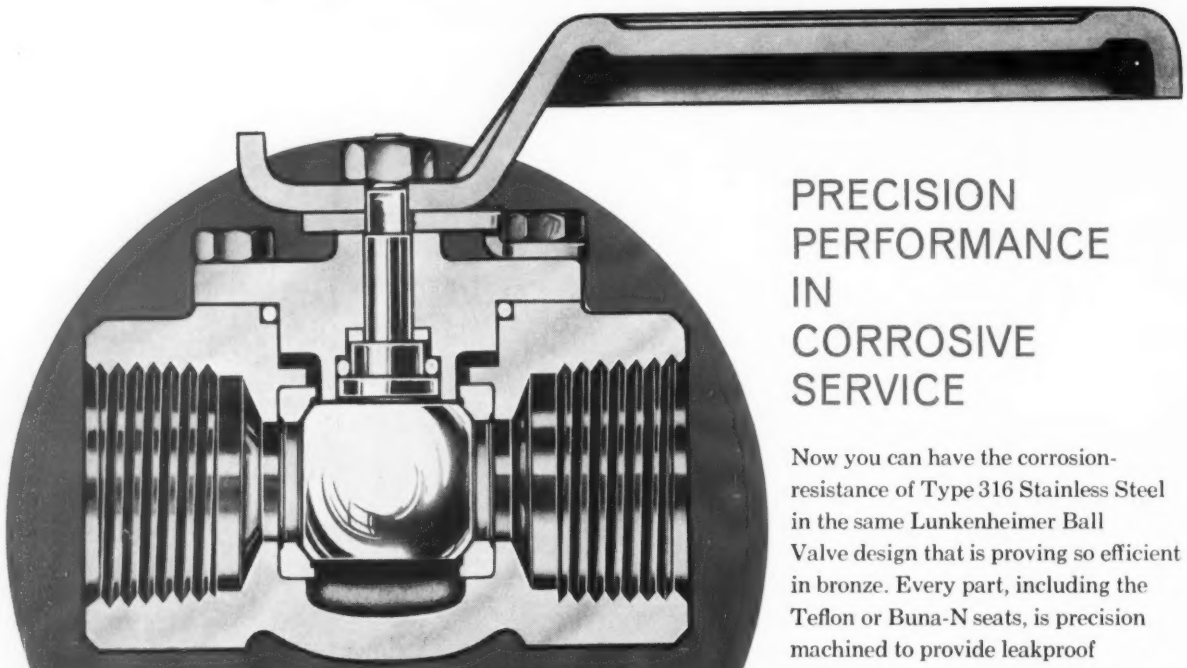
NEW LUNKENHEIMER STAINLESS STEEL BALL VALVE



Figs. 704-T and 704-B—TYPE 316 STAINLESS STEEL—SIZES ¼" to 2"
TEFLON OR BUNA-N SEATS AND SEALS

- TOP ENTRY FOR EASY IN-LINE MAINTENANCE
- QUARTER-TURN OPERATION
- SELF-ALIGNING BALL
- STRAIGHT-THROUGH FLOW
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Now you can have the corrosion-resistance of Type 316 Stainless Steel in the same Lunkenheimer Ball Valve design that is proving so efficient in bronze. Every part, including the Teflon or Buna-N seats, is precision machined to provide leakproof performance in corrosive liquids, gases, and slurries. Corrosive atmospheres are no threat to solid Stainless Steel bodies and bonnets. Recommended for both pressure and vacuum applications.

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L-561 24

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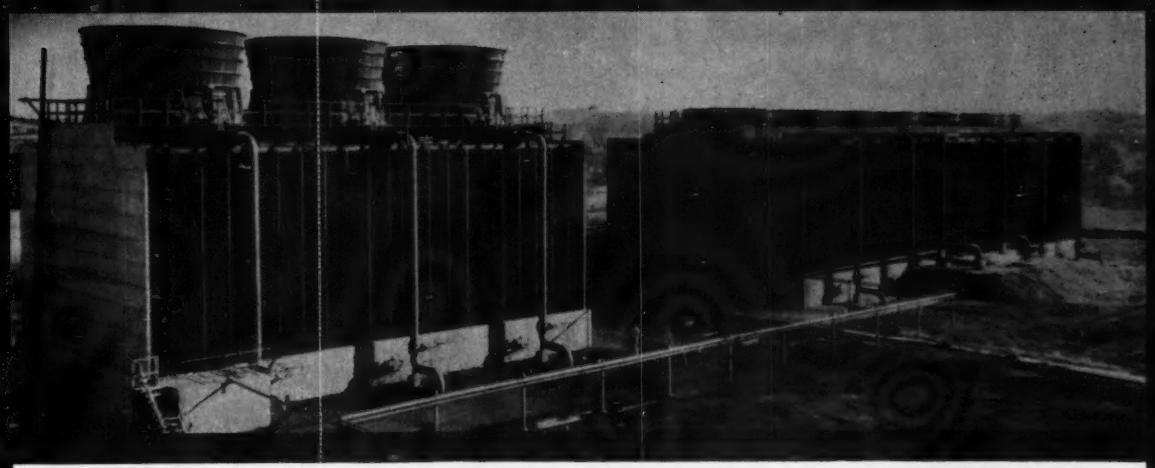
again and again and again...



Cooling System No. 2 at Iowa Southern Utilities Company's Bridgeport Station circulates 19,000 gpm and includes this Tower. Inlet temperatures range from 83 to 90°F; outlet temperatures 70 to 75°F. To this System, Dearborn 860 with Endcor B was fed for comparative tests with System No. 1 in which prior treatment was continued. Corrosion testers installed in by-pass lines of the return water riser in each Tower gave comparative results—serious localized or pitting type corrosion at a rate averaging 10 to 12 mils per year in System No. 1; complete absence of pitting and a corrosion rate of only 1.2 mils in System No. 2 using 860 with Endcor B.

Endcor® proves its superiority in cooling water treatment

Whether it's Endcor A combined in polychromate formulations or Endcor B in non-toxic dimetallic polyphosphates, these organic additives—developed in Dearborn's research laboratories—continue to prove their superiority *in actual plant operation everywhere.*

For example, at Iowa Southern Utilities' modern 66,000 KW Bridgeport generating station (Eddyville, Iowa) Dearborn® 860 with Endcor B *completely eliminated* pitting and reduced the corrosion rate from 12 to 1.2 mils per year. It also produced a significant reduction in the reversion rate of polyphosphates as compared with the previous sodium hexametaphosphate and tannin treatment. Results: First, economy, since more polyphosphate is available per unit fed; second, improved performance, because of less insoluble phosphates to deposit in heat exchangers.

But there's more involved in Dearborn service than just product superiority. There's the important "plus" of Dearborn's water treatment experience—from source to re-use—dating back to 1887—longest in the field. There's its extensive research and analytical facilities...its Technical Centers in Chicago and Toronto, staffed with recognized experts to analyze and solve specific problems . . . to make certain that Dearborn products and equipment give top performance always.

It always pays to check with Dearborn. Consult your nearest Dearborn representative, without cost or obligation. Or write for Technical Bulletins on Endcor products now available.

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speaking of **Power**

BETTY FURNESS

TV studios are way off a POWER editor's beat. But when hurricane Esther came ablowing up the East Coast, Managing Editor Jim O'Connor was asked to serve as a panelist on the Betty Furness TV show *At Your Beck and Call* to answer telephoned queries about restoring flooded equipment.

Learning of his role while on vacation, just 48 hours before show time, Jim rethought many of his on-the-job flood experiences, reviewed POWER reports on the subject, then bought the customary light-blue shirt and black tie.

The panel—O'Connor and Rep John Lindsay of New York; Dr Rose Franzblau, a psychologist and columnist; Homer Croy, author and expert on Western lore—were together in the studio briefing room 30 minutes before show time for an informal meeting with moderator Betty Furness.

But it didn't work out that way, at least not on the night of Friday, Sept 22. New York traffic was overly heavy and Miss Furness just about made it to the studio. Jim first met her on the set a slim five minutes or so before camera time, a fact that led to his introduction as a "hurricane expert." It took a little doing to reorient the audience, but Jim finally managed it.

After shedding the TV-blue shirt and black tie, Jim turned editorial attention to the important matter of electronic data-processing equipment: how errors and lost time stem directly from transients that creep into the electric supply. For his report turn to p 57.

Lou Rowley

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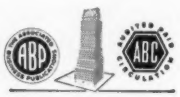

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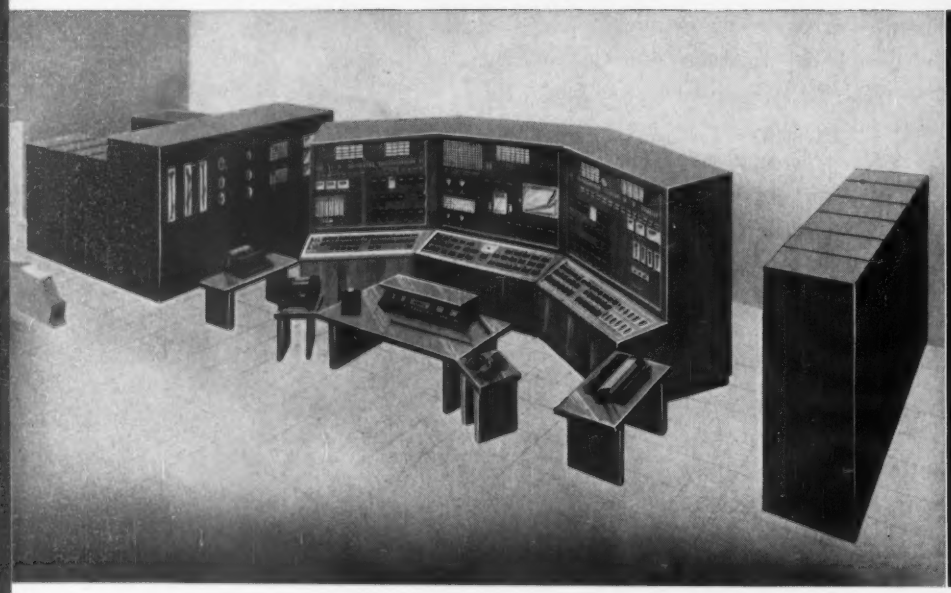
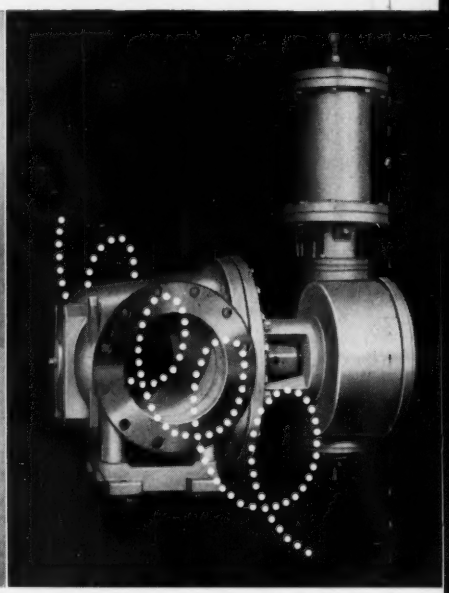
Current news reports

WHAT'S HAPPENING IN POWER SERVICES?

Highlights: A high voltage control center that requires half as much floor space. Smaller power transformers with considerably more kva capacity. These examples demonstrate the extra value that is standard with Allis-Chalmers . . . the greater efficiency and the added productivity that are yours when you buy A-C products, systems and services. Call your nearby Allis-Chalmers office for details or write Allis-Chalmers, Industries Group, Milwaukee 1, Wisconsin.

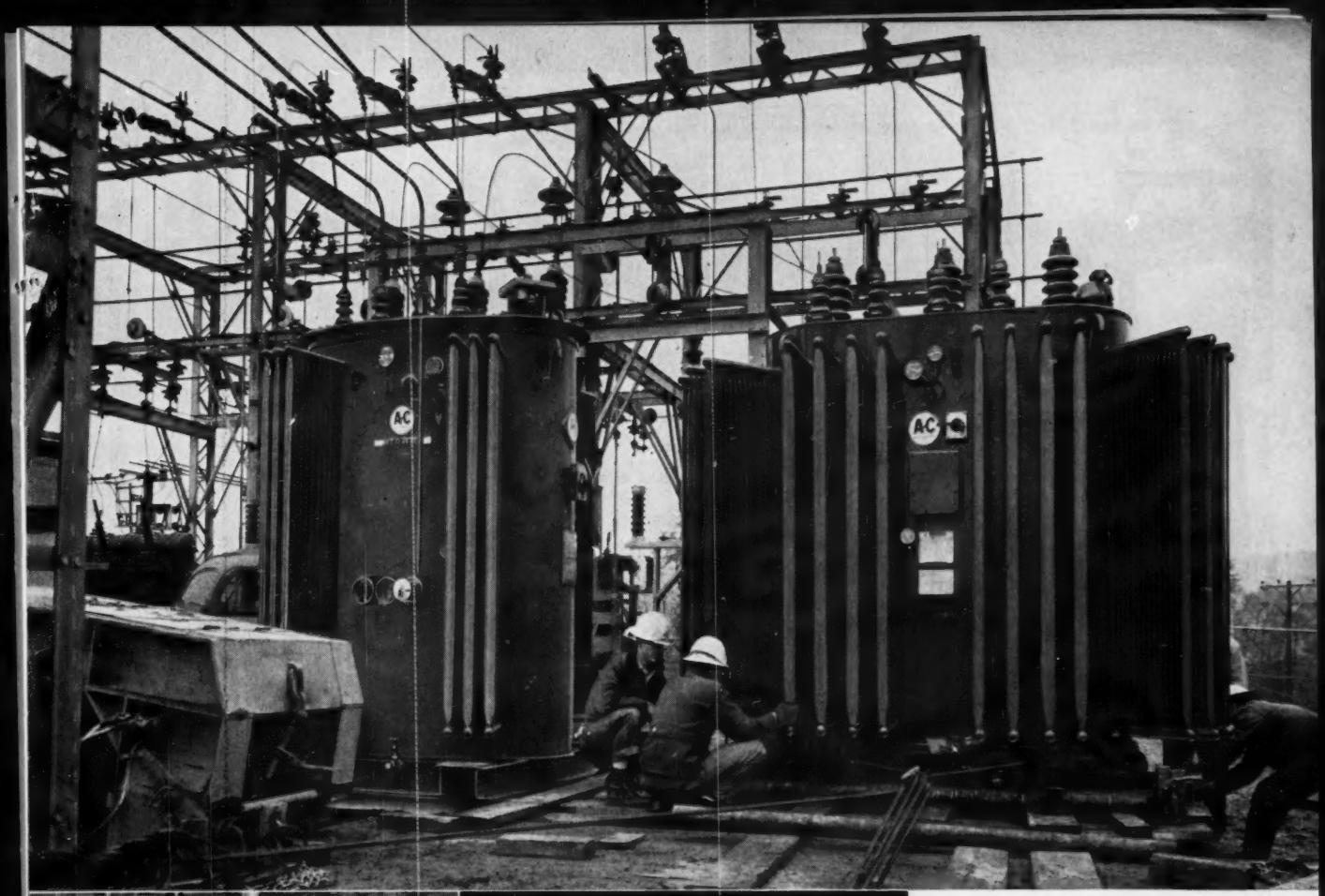


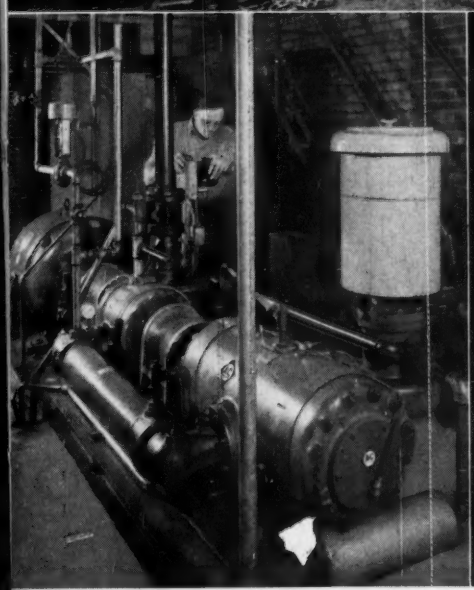


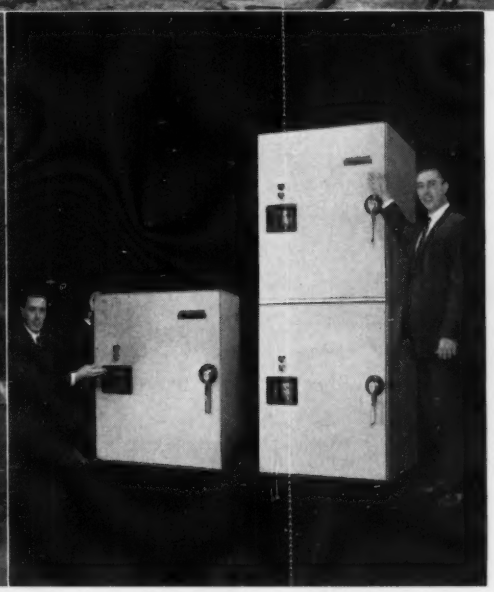
For quality control . . . lower power costs: With the acquisition of Consolidated Systems Corporation last year, Allis-Chalmers extended its ability in the areas of data gathering, handling and utilization. CSC provides such experience acquired from more than 500 successful system projects. Recently, Allis-Chalmers, Consolidated Systems and International Business Machines Corporation effected a nonexclusive mutual agreement relating to the production and marketing of automated control systems.

For the typical system, A-C takes functional responsibility for the system using IBM data processing computer equipment, CSC specially engineered data conditioning equipment, instrumentation, and A-C power and industrial processing equipment. Now, Allis-Chalmers brings balance of specialized judgments to bear on your problems . . . drawn on significant experience . . . to make major "contributions to the art" in many phases of *Systemation* and help you be sure before you invest.

"Open road" for unrestricted flow: This *Rotovalve*, when wide open, offers no greater resistance to flow than a straight pipe of equivalent length. Promotes lower pumping costs. Actually seats itself tighter with use. And special shutoff characteristics reduce water hammer. All moving parts are totally enclosed, yet easily accessible.







Transformers "grow up" but don't get bigger: New Allis-Chalmers transformers deliver as much as a 30% increase in kva without any increase in size or weight. This permits replacement of old transformers without altering base mountings or overhead structures. This unit being installed has twice the rating of the neighboring 3500-kva transformer.

More air . . . less wear, with vibration-free compressors: *Ro-Flo* compressors with sliding-vane rotary design eliminate operating losses inherent in reciprocating machines. Centrifugal force keeps vanes in close contact with cylinder walls, automatically compensating for wear. In addition, fewer moving parts result in less wear, reduced maintenance costs.

So low, two fit where one used to go: This new *SpaceMaker* control center is the first completely new 2- to 5-kv motor controller development in more than a decade. New, compact two-high design can cut floor space requirements in half. Complete drawout construction makes it the safest, most easily accessible controller on the market. New flame-retardent, track-resistant Super *Pyro-Shield* insulation adds to reliability, reduces size and weight.

A-1522

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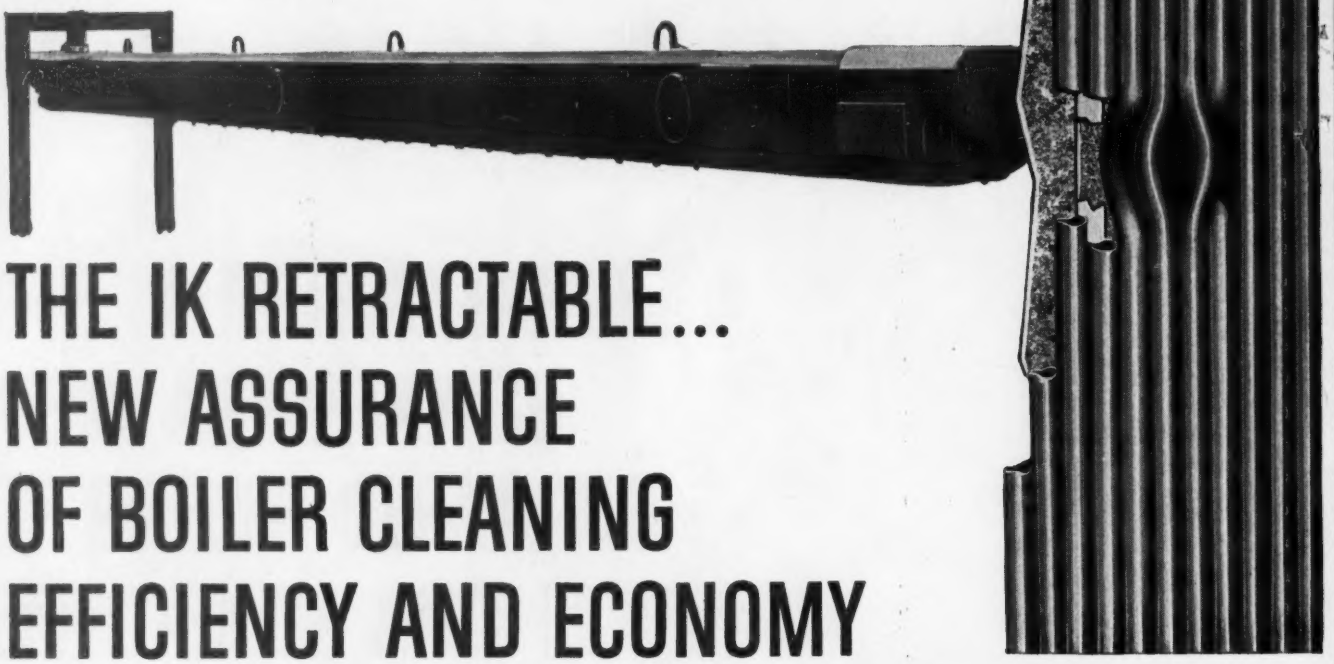
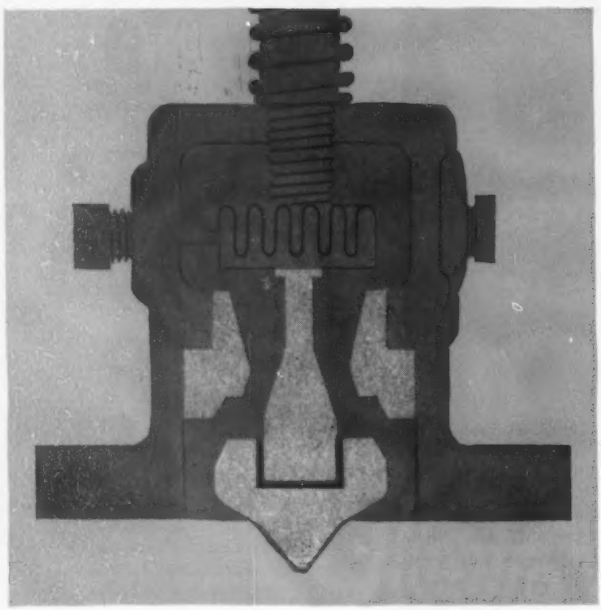
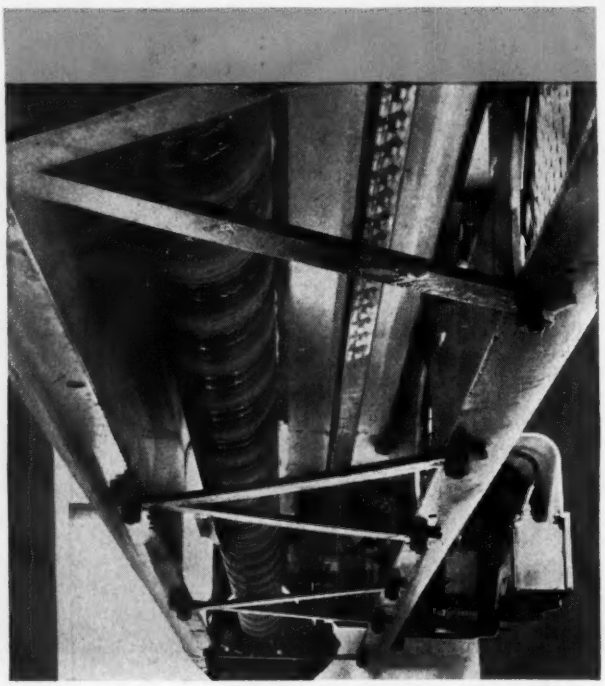


THE IK RETRACTABLE... NEW ASSURANCE OF BOILER CLEANING EFFICIENCY AND ECONOMY

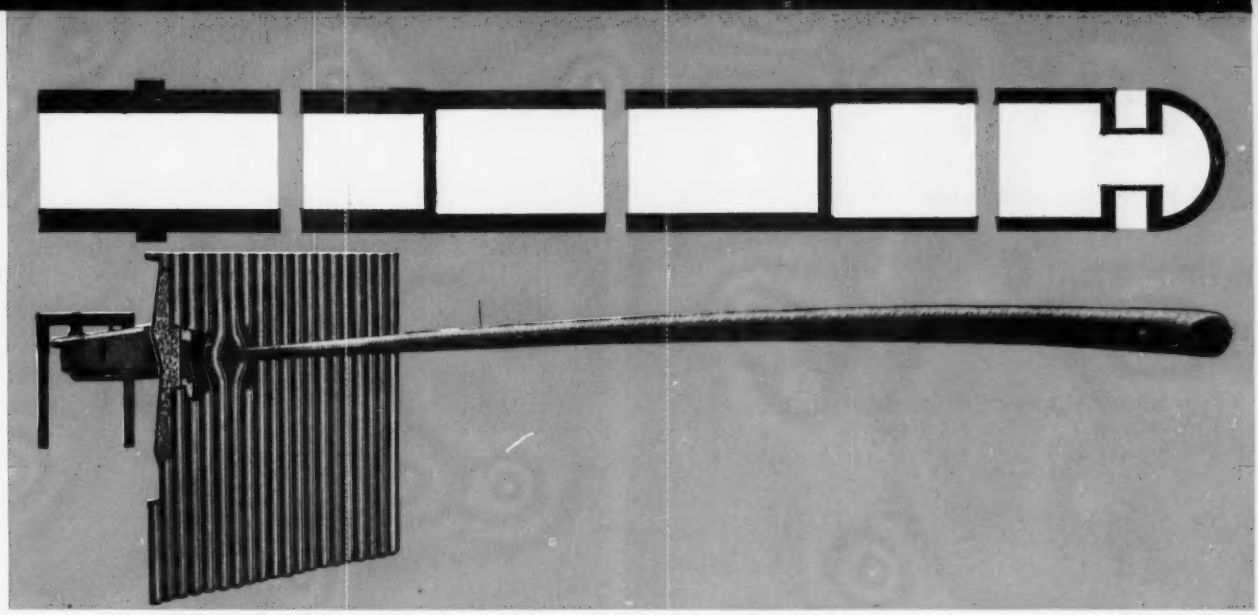
For years . . . in thousands of boilers . . . the Diamond IK Long Retractable Blower . . . with its close-cleaning helix, positive rack-and-pinion drive and single motor . . . has provided maximum cleaning effectiveness at lowest possible cost. Now, thanks to seven new major design improvements, the IK assures even better performance. Examine them carefully and you'll soon see why.



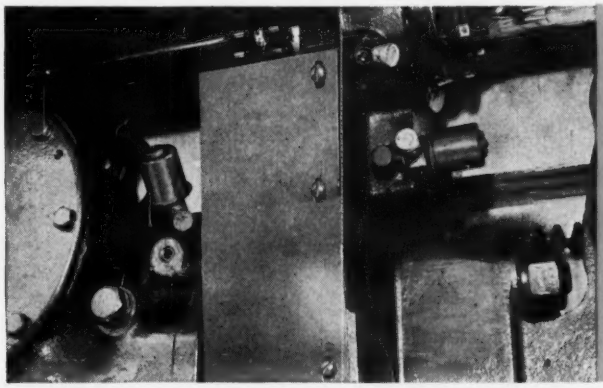
1 Minimizes valve leakage problems . . . flexible valve arrangement. In most valves, differentials in valve body temperatures produce distortion which causes leakage. In the new IK valve, this problem has been solved. Critical valve internals expand and contract *with* temperature changes, thereby eliminating distortion and drastically reducing the possibility of costly leakage.

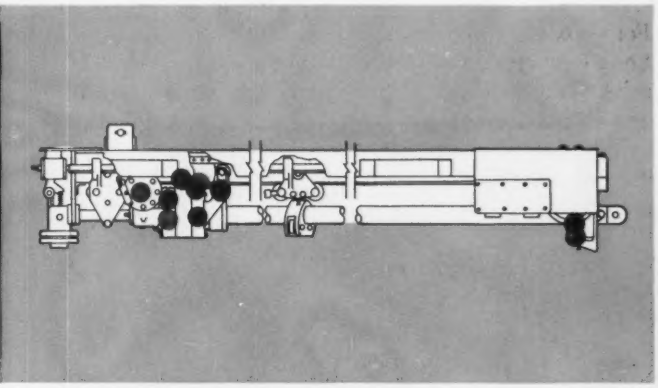


2 Ample coverage to clean the biggest boilers . . . box-type beam. For cleaning coverage over 34 feet, the Diamond IK Series 400 features a new box-type beam construction. This design retains the simplicity and convenience of two-point blower support with 6 inch trolley beam, yet assures ample strength and rigidity for stable, uniform lance travels to 42 feet and over. It also improves blower appearance and provides protection during installation. (Note: The evenly spaced roller marks on the retracted lance attest to the IK's exclusive "every inch" cleaning helix. It's your assurance of uniform, complete cleaning . . . *regardless* of tube bank arrangement and tube spacing.)



3 Reduced lance deflection and less wobble for longer travels . . . stronger lance. To minimize lance deflection where cleaning coverage is over 34 feet, Diamond uses a 3¾″ O.D. lance instead of a 3½″ O.D. lance. To further reduce lance deflection, the standard Diamond step-tapered lance tube construction is used. This rigid construction combined with the heavier lance support and box-type beam enclosure used on the Series 400 blower, assures stable lance travel and effective, uniform cleaning . . . for furnace coverage to 42 feet and over.





4 Mini-Lube . . . slashes need for maintenance manpower with once-a-year lubrication concept. To reduce costly blower lubrication, the number of lubrication points on the new IK has been cut from eighteen to only eleven. What's more, frequency of lubrication is greatly reduced . . . for instance, blowers operated three times daily should not require lubrication more than once a year. Figure it out! Mini-Lube can save thousands of dollars yearly in maintenance costs; helps keep your IK's in peak operating condition with minimum attention. (Photo shows some of the easily accessible lubrication fittings; the schematic drawing shows all of the lubrication points).

5 Multi-speed drives . . . less blowing medium . . . less cleaning time. A considerable reduction in cleaning cycle time with consequent reduction in blowing medium requirements (up to 25% savings) can be achieved through proper application of 2-speed electric motor dr[illegible].*

6 Less stack emission by spaced blowing. More frequent but shorter cleaning cycles can be used in easy-to-clean zones. For any single cleaning cycle, this means a significant reduction in stack emission.

7 Insulated feed tube . . . reduced packing maintenance with steam blowing. A double-tube construction, with insulating air space between the two tubes, minimizes frequency of replacement of packing and shows significant savings compared with single-tube construction, for blowing steam temperatures of 750F and over.*

For most effective cleaning of pendant and horizontal tube surfaces the Diamond IK Long Retractable Blower is your assurance of unmatched performance and economy. Call, write, or wire for complete information.

**Available at slight additional cost.*

DIAMOND POWER

DIAMOND POWER SPECIALTY CORPORATION, Lancaster, Ohio
DIAMOND SPECIALTY LIMITED, Windsor, Ontario

9:02

Motor stopped; disassembly begun.

9:20

Sufficiently disassembled
to permit bearing inspection.

Westinghouse F/A motor completely disassembled in 90 minutes

"F/A" means "Fully Accessible" . . . Only 90 minutes are required for a complete disassembly. After cleaning, inspecting and servicing, the F/A motor can be completely reassembled and put back in operation in about two hours.

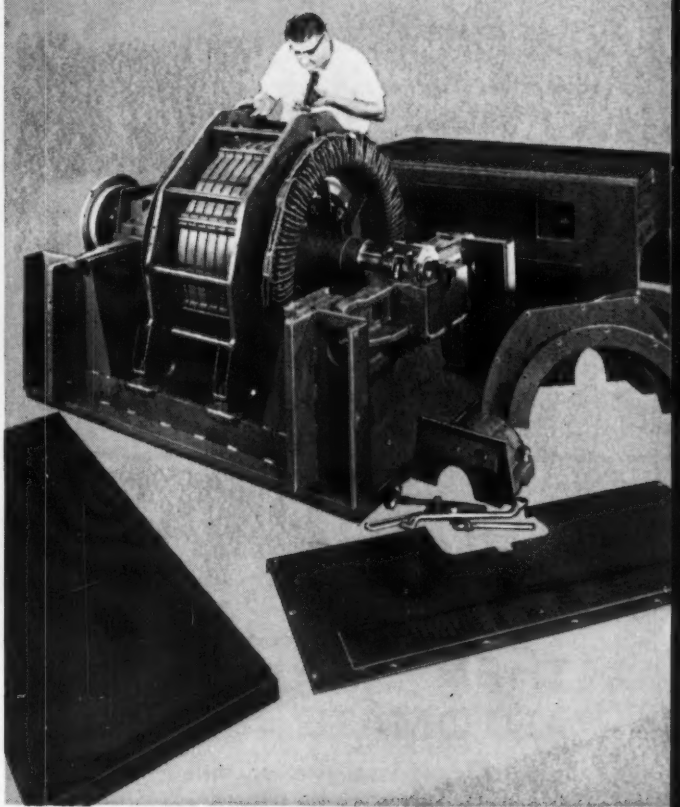
No other motor can be serviced so quickly. One electric utility maintenance engineer estimates that

9:40

End covers, side panels, air shields removed. Winding inspection now possible.

10:32

Complete disassembly possible for major cleaning, inspection and servicing.



a Westinghouse F/A motor can be serviced in about one-fourth the normal time.

F/A motors are available in ratings from 250 hp/600 rpm to 7,000 hp/3600 rpm. For more information, call your Westinghouse Representative. Or, write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. *You can be sure . . . if it's*

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Westinghouse

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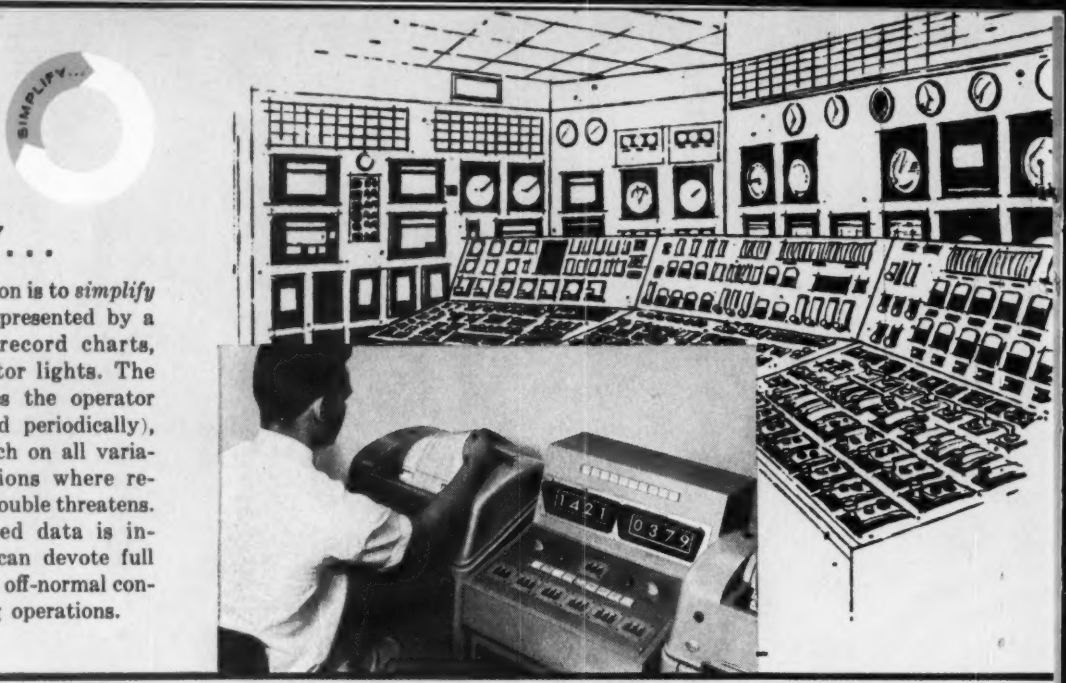
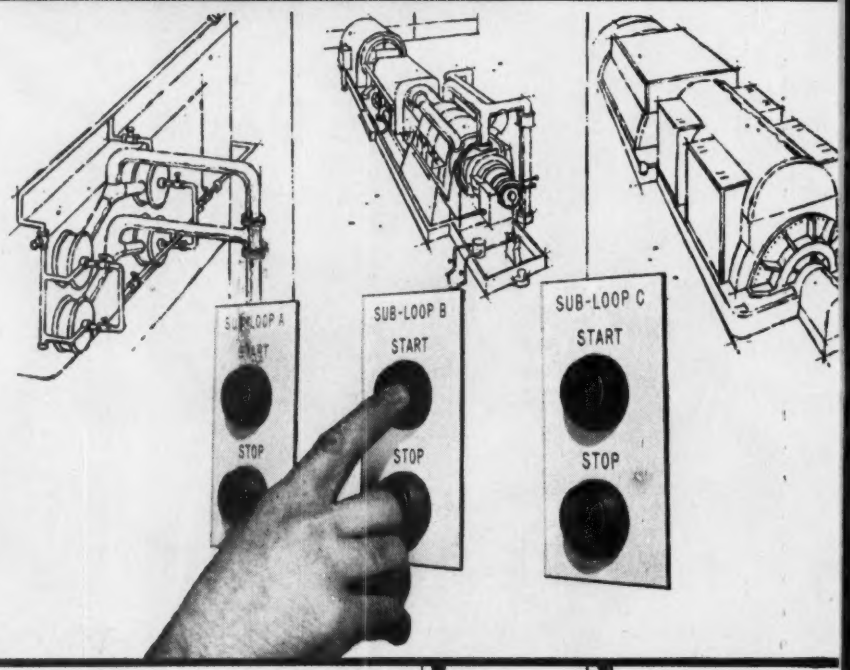


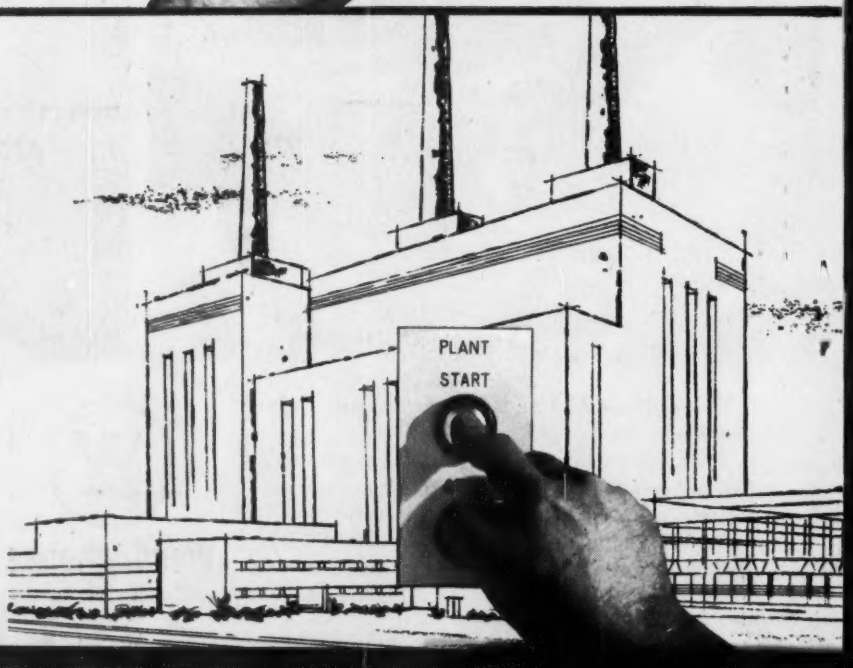
FIRST SIMPLIFY...

First step to automation is to *simplify* the information now presented by a multitude of multi-record charts, gages, and annunciator lights. The Bailey approach gives the operator data he needs (logged periodically), keeps continuous watch on all variables, makes calculations where required, alarms when trouble threatens. Reliability of recorded data is increased . . . operators can devote full attention to correcting off-normal conditions and improving operations.



NEXT VERIFY...

Next, verify the practicability of automation by extending supervisory controls, letting equipment perform more operating functions. Automate key systems, one at a time, by push-button controlled sub-loops. This approach smooths the transition to complete automation and improves safety to men and machinery by providing safe, uniform start-up, shut-down, and normal operating procedures.



THEN AUTOMATE

Final steps to automation can then be made at any time with full confidence and proved operational experience. These steps are: 1) to consolidate supervisory controls, conventional controls, and sub-loops for full-range automatic operation once the plant has been placed on the line; and 2) ultimately, to add start-stop control to provide full automation.

How to get *assured results* from AUTOMATION

...and gain as you go

Complete automation is a long step forward — with many challenges along the way.

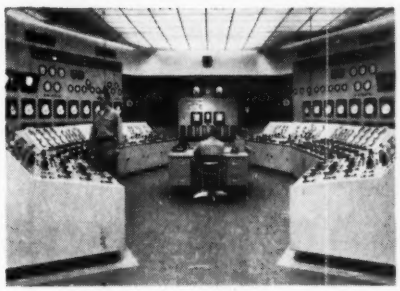
The Bailey step-by-step approach to automation makes possible step-by-step certainty ... provides step-by-step benefits ... requires only step-by-step commitment.

In the initial steps it makes possible many or most of the benefits of complete automation with considerably less investment than required for the ultimate. And it permits the decision to take each succeeding step to be made only after satisfactory evidence that it is economically justified and functionally sound.

Bailey 700 Systems draw on the best available techniques, including analog and digital manipulation, trend recording, time sharing, scanning, alarming, calculating, controlling, and logging, as required to meet operating objectives. Individual systems, including logic and sequence units, are coordinated by Bailey's distinctive method of *parallel programming* to achieve plant automation. The parallel-programming approach improves plant availability by making it practical to remove individual systems from service or reprogram without disturbing operation.

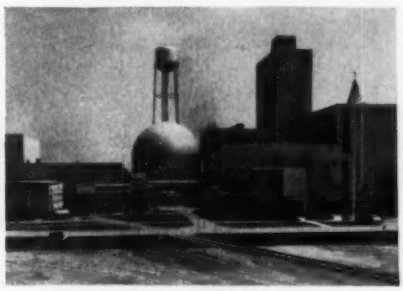
Ask your Bailey District Office, or write for more information on the Bailey step-by-step approach to automation with Bailey 700 Systems. Bailey Meter Company, 1036 Ivanhoe Road, Cleveland 10, Ohio. In Canada —Bailey Meter Company Limited, Montreal.

Bailey Systems Concepts are Founded on 45 years of Experience



Twenty-one of the twenty-six most efficient steam-electric stations in the United States use Bailey Instruments and Controls.* This reflects more than 45 years of Bailey developments devoted to improving the reliability of power-plant operation. **Listed in Federal Power Commission Report S-143.*

Bailey experience in automation dates from electrically operated boiler controls in 1924, automatic start of boiler controls on steam-electric locomotive in 1936, and fully automated package boilers in 1948. This Bailey 750 System for simplified display of power-plant operating information was installed in 1959.



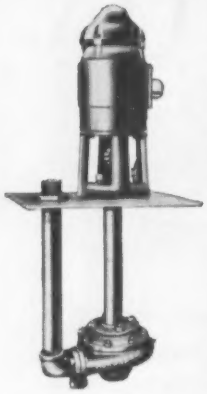
Bailey experience extends to and includes the atomic power field. In the completion of the Enrico Fermi Atomic Power Plant at Monroe, Mich. in 1961, Bailey Meter Company was prime instrument contractor, supplying both pneumatic and transistorized electronic control systems. A165-2

BAILEY METER COMPANY

700 Systems

For more facts circle 208 on Reader Service card, p 99

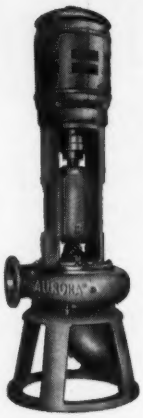
AURORA® CENTRIFUGAL PUMPS



DEPENDABLE, EFFICIENT, COMPACT, ECONOMICAL

FOR: Water Supply • Circulating • Chemical Handling • Transfer • Condensation • Sewage • Construction • Marine • Washing • Cooling • General Services

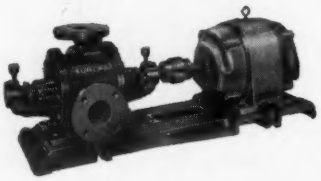
• Long-term Top Performance • High Efficiency • Design Simplicity—Ruggedness • Balanced Impellers—Maximum Smoothness and Quietness • Easy Maintenance • Packing or Mechanical Seals • Experienced Pump Engineering

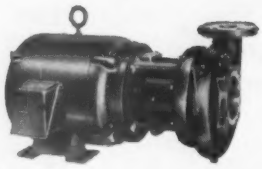


SUMP PUMPS—particularly applicable for lift services or handling heavy or viscous liquids and solids in suspension. Capacities to 1500 GPM. Heads to 170 feet.

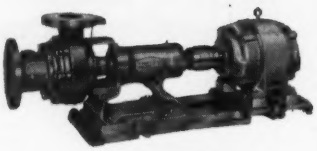
NON-CLOG PUMPS—vertical or horizontal—enclosed or mono-vane impellers—handles heavy liquids or solids in suspension. Capacities to 8000 GPM. Heads to 150 feet.

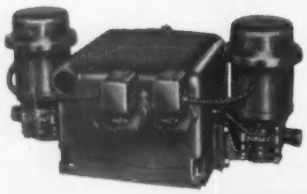
APCO TURBINE TYPE PUMPS—single or two stage—with multi-vane impellers handle entrained vapor and air along with the liquid, thereby eliminating vapor lock. Capacities to 150 GPM. Pressures to 400 PSI.



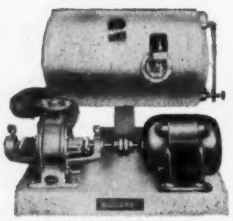


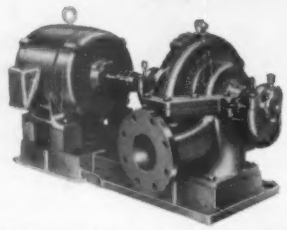
END SUCTION PUMPS—horizontal or vertical—self venting with vertical discharge . . . close coupled or flexible coupled. Capacities to 1800 GPM. Heads to 320 feet.



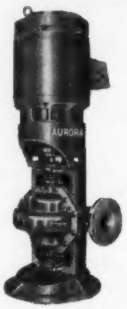


CONDENSATE RETURN UNITS—low NPSH—smooth, quiet operation—simplex or duplex—horizontal or vertical—ready for connection to lead lines. Capacities to 150,000 EDR. Pressures to 125 PSI.





SPLIT CASE PUMPS—horizontal or vertical—horizontally or diagonally split cases . . . single stage double suction or two stage opposed suction. Capacities to 6000 GPM. Heads to 600 feet.



Write Or Call For Complete Information

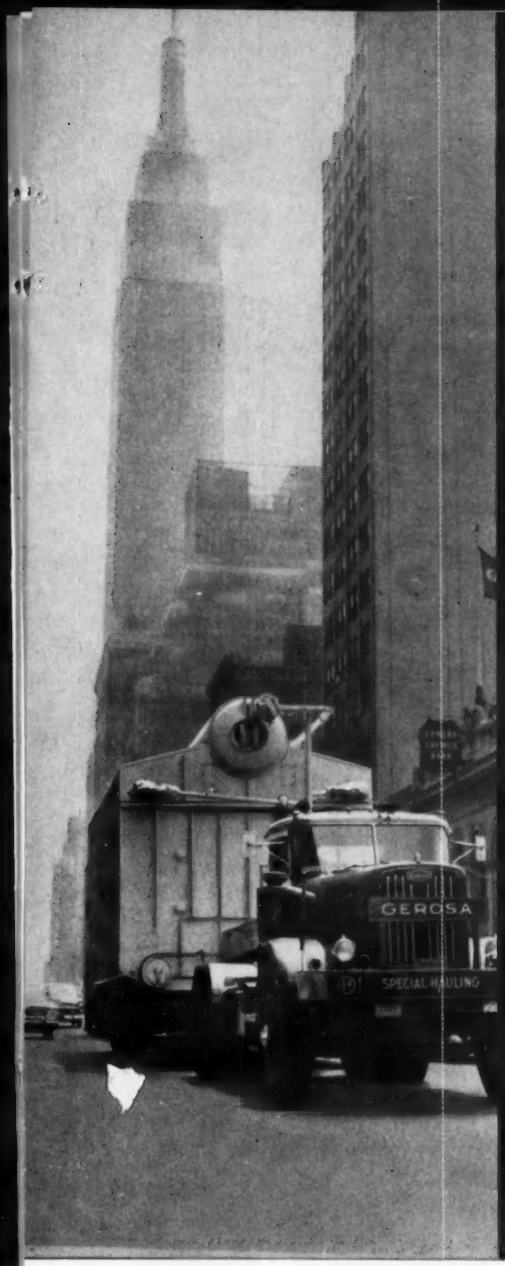
Local Distributor Is Listed In the Yellow Pages Of Your Phone Book.

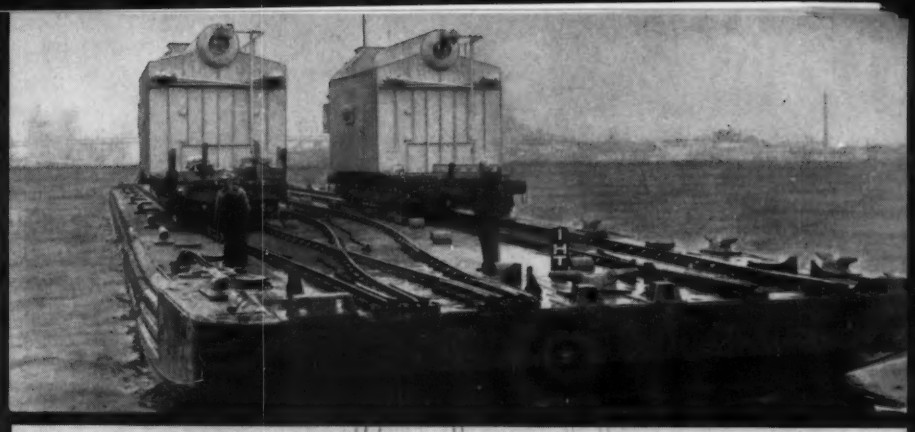
AURORA Always PUMPS

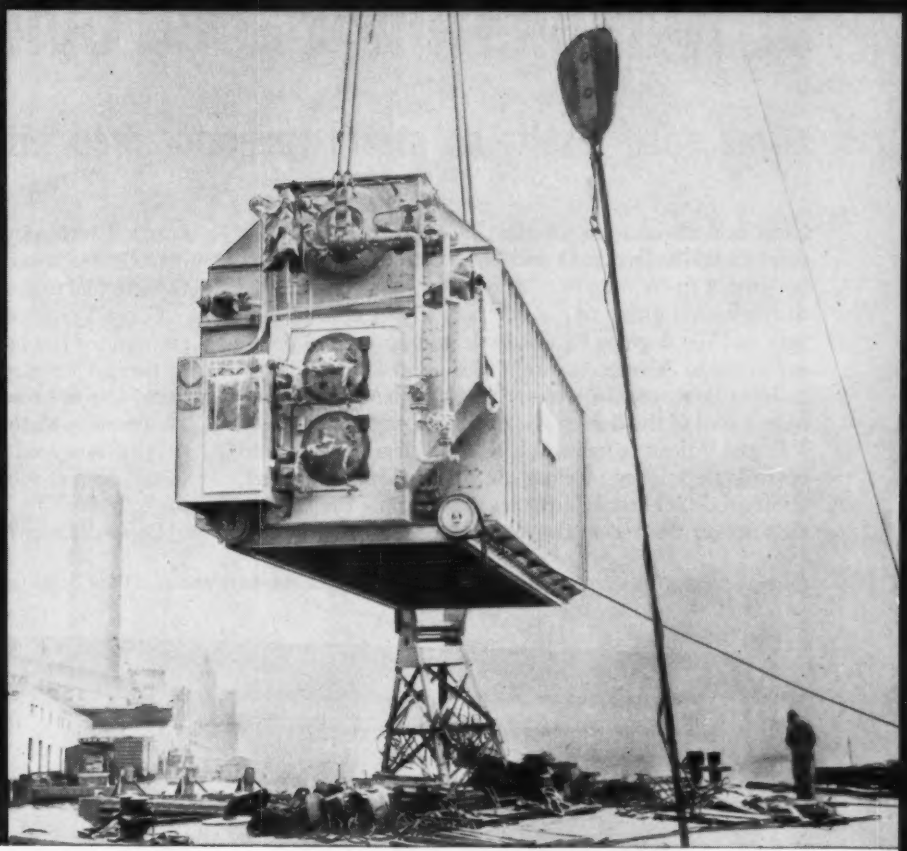
AURORA PUMP DIVISION

THE NEW YORK AIR BRAKE COMPANY

1000 LOUCKS • AURORA, ILLINOIS







VIA RAIL, BARGE AND TRUCK:

two 100,000 lb/hr steam generators move into heart of New York City

En route to Pennsylvania Station South Housing Project in Manhattan, this pair of Union Type MH Packaged Steam Generators demonstrates how steam requirements (in excess of 100,000 lbs./hr.) can be fulfilled without involving field assembly.

Placed by the contractor, Raisler Corporation, the two units were shipped complete with refractories, casing, MH Firing Units, and connecting duct work. Equipped for burning No. 6 oil, each of the MH's has a capacity of 100,000 lbs./hr. at 450 psi and 600° F.

Shop assembled to standardized designs, Type MH Steam Generators and Firing Units can be supplied to handle diversified needs without costly special engineering. They can be arranged for oil or gas firing or both, with fully automatic, semi-automatic or manual control. The symmetrical, 3-drum MH design, with the top drum centered, makes it possible to ship larger units within existing rail clearances.

For detailed information, contact your local Riley Stoker Corporation or Union Iron Works office.

UNION

UNION IRON WORKS
ERIE, PENNSYLVANIA
A DIVISION OF RILEY STOKER CORP.

For more facts circle 210 on Reader Service card, p 99

Copes-Vulcan automatic boiler control at Hammermill Paper Company

Gives good results on steam generator fired with hogged bark and coal

Here was an unusual problem of boiler control. Two solid fuels—hogged bark and bituminous coal—were to be burned in combination. The Riley steam generator, with nominal rating of 206,000 pounds per hour at 675 psig and 760 degrees F., was to deliver power and process steam to the same main header as all other existing boilers. Low steam costs and high boiler availability were a goal of the design and operating engineers.

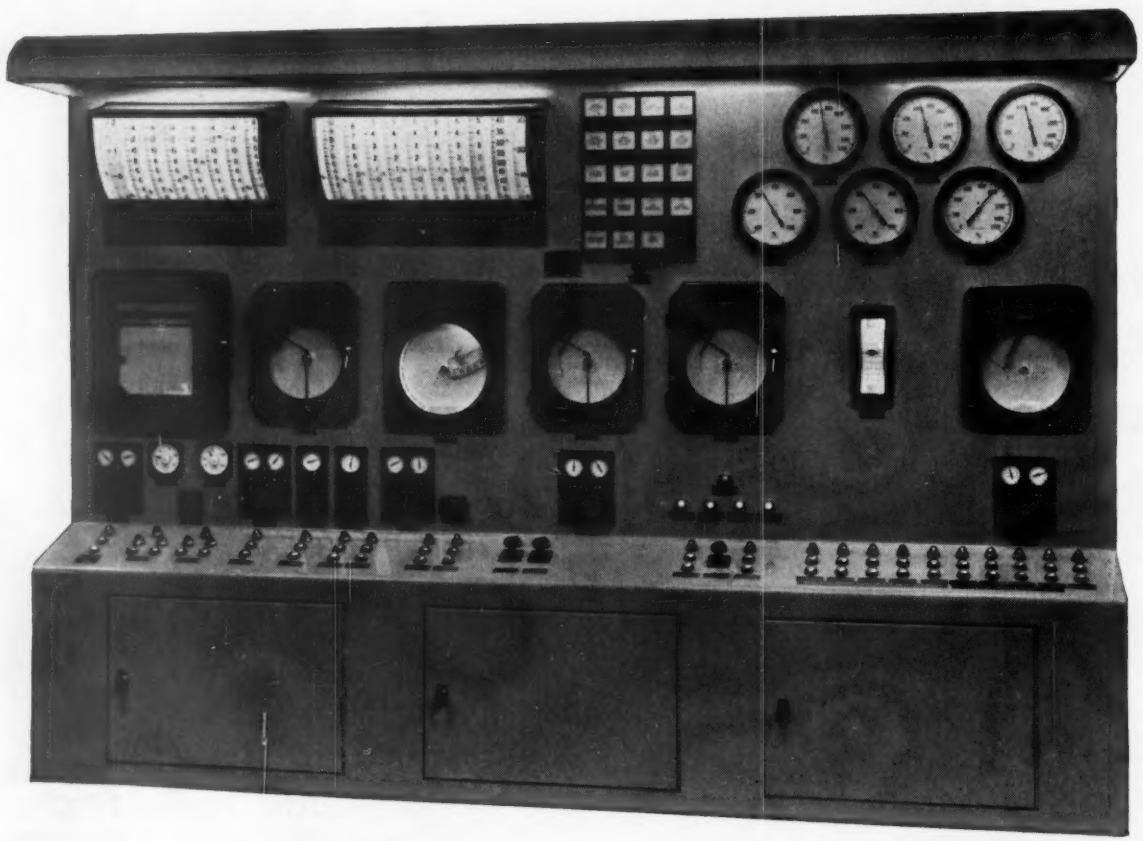
Copes-Vulcan combustion control has given high operating efficiency by close control of excess air. It has minimized fuel-bed disturbances by keeping the flow of air through the bed at the lowest practical rate. It has handled intermittent flows of waste fuel without incident. It has required no manual adjustments for variations in fuel moisture or quality, or in kind of fuel.

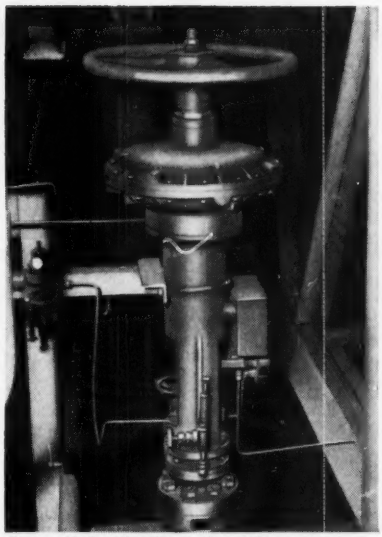
Copes-Vulcan three-influence feedwater control has maintained the proper drum level while feeding exactly as needed for steam output. Regardless of load conditions, Copes-Vulcan control has maintained final steam temperature at the desired 760 degrees F.

Why not read the complete story of this unusual installation as told in the new Bulletin No. 1078. Write for it today.

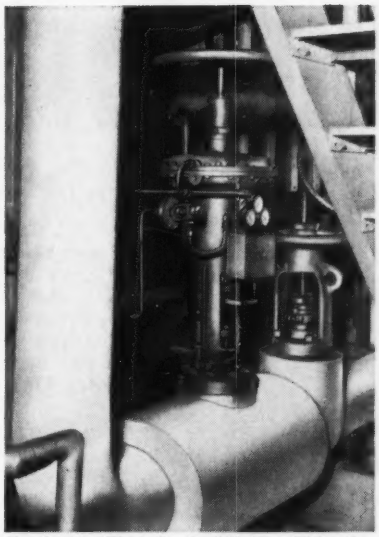
Copes-Vulcan Division, Erie 4, Pennsylvania.

Central Control Panel. All recorders and controls for the bark-and-coal-fired boiler are centralized on this Copes-Vulcan panel.

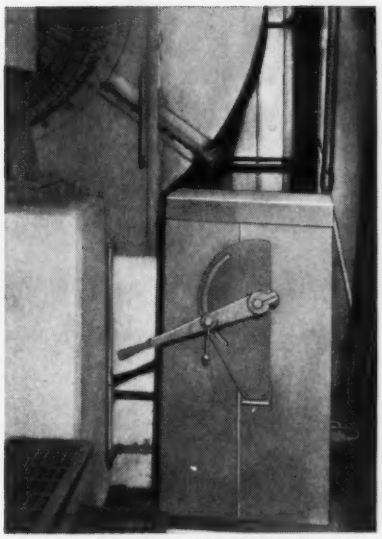




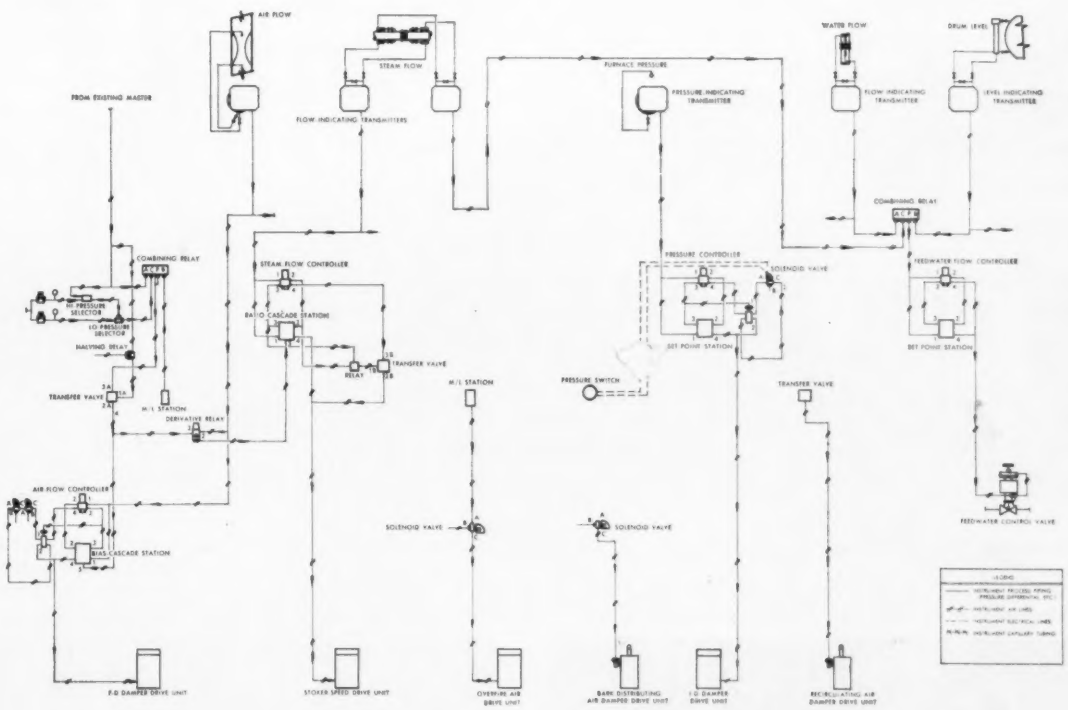
Spray Valve for Superheat Temperature Control. This Copes-Vulcan Type CV-D Spray Valve introduces cooling water into the superheater for dependably accurate steam-temperature control.



Feedwater-Flow Control Valve. This diaphragm-operated Type CV-D valve is part of the Copes-Vulcan three-influence feedwater control system.



Drive Unit for Forced-Draft Fan Damper. This Copes-Vulcan drive unit, one of several in the control system, positions the forced-draft fan damper.



Schematic diagram of the Copes-Vulcan combustion and feed-water control systems on the bark-and-coal-fired boiler at Hammermill Paper Company.

Copes-Vulcan Division

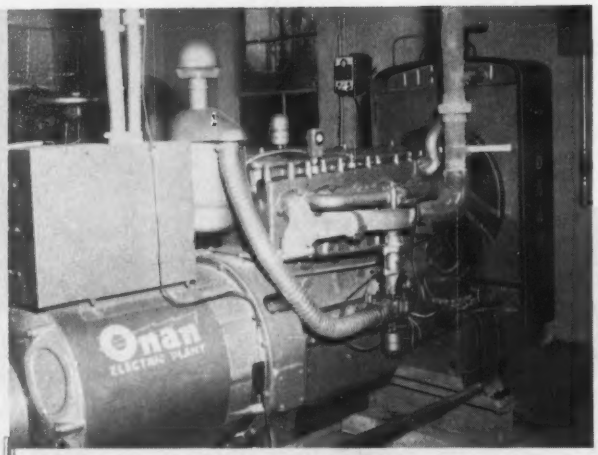
BLAW-KNOX

BLAW-KNOX

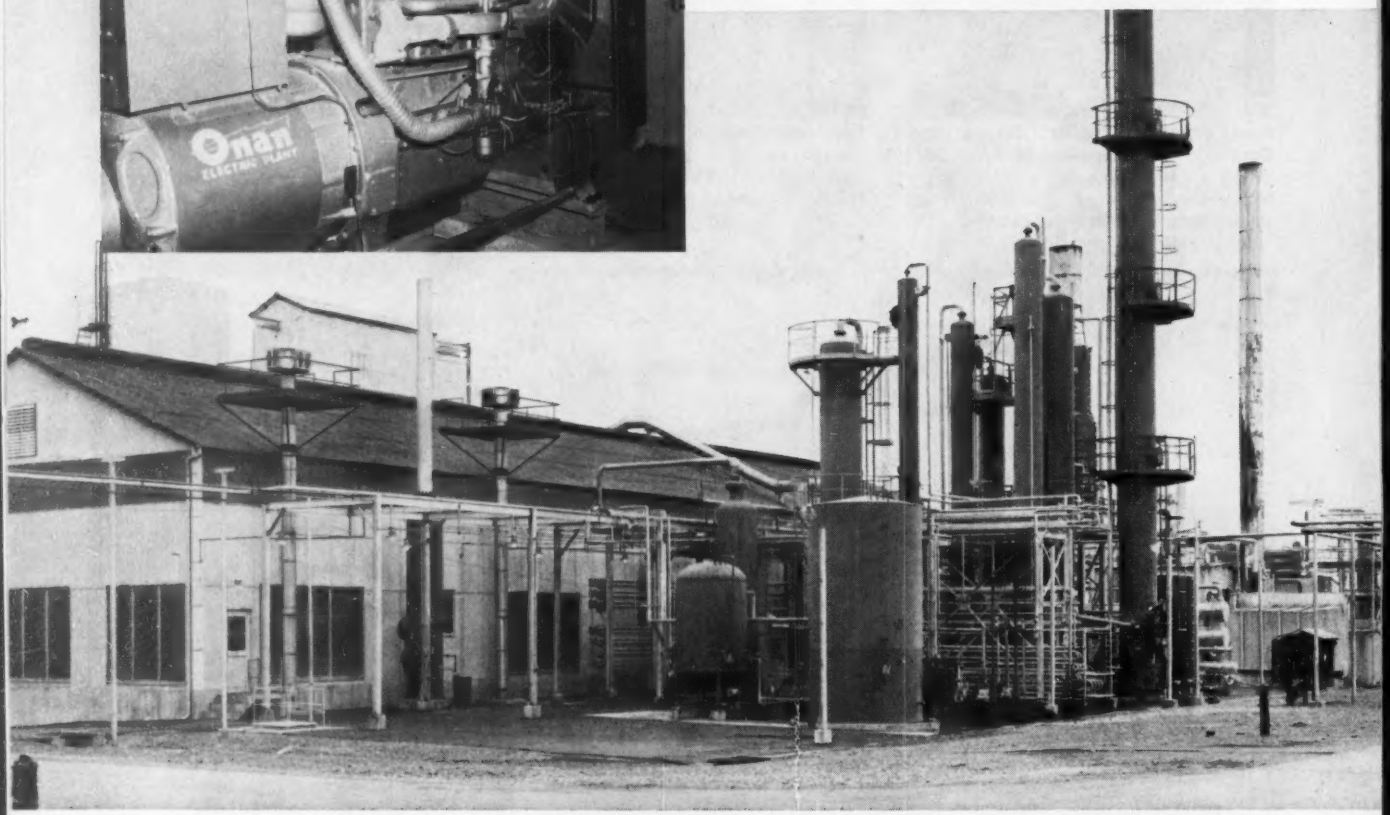
Blaw-Knox designs and manufactures for America's growth industries: METALS: Rolling Mills • Steel Processing Lines • Rolls • Castings • Open Hearth Specialties • PROCESSING: Process Design, Engineering and Plant Construction Services • Process Equipment and Pressure Piping • CONSTRUCTION: Concrete and Bituminous Paving Machines • Concrete Batching Plants and Forms • Gratings • AEROSPACE: Fixed and Steerable Antennas • Radio Telescopes • Towers and Special Structures • POWER: Power Plant Specialties and Valves

For more facts circle 211 on Reader Service card, p 99

Beefed up for hardest



For portable electric power or standby for critical process, you can't afford to gamble on auxiliary power failure. That's why Onan gives every plant the toughest possible tests before it's shipped to you. *Only* Onan is certified to deliver every watt of power the nameplate promises. Before you buy any electric plant, talk to your Onan distributor. He's in the Yellow Pages.



Stellite coated exhaust valves and valve seats. One of toughest alloys known. Gives you up to 300% longer valve life than uncoated valves. It's the important details like this that make Onan more economical in the long run.

Exacting standards govern manufacture—years of specialized experience and extensive testing facilities control the quality of Onan Power Plants. Over 1000 different types and sizes of plants are produced by Onan.

use...even abuse

Onan electric plant still delivers full power after 12,197 hour test—equal to 487,888 miles

A grueling endurance test that lasted one year, nine months and 12 days could not stop Onan test plant #1068. Onan engineers used this production-built unit for an endurance run—and after it was all over, it still generated the full rated power promised on the nameplate. Proof that Onan's exacting standards and production testing give you a power plant with long, dependable life built in.

Over 1,700 other endurance units have been run by Onan engineers. In these tests every design feature and part has to prove itself before it can become a part of the Onan you buy. In addition, every type and size Onan plant is tested under all operating conditions which could conceivably affect performance on your job.

Hours of running in and testing under full load are given *every* Onan before it is shipped. An independent testing laboratory then spot tests Onan Plants that have already been tested by Onan—double assurance that every Onan will deliver its full nameplate rating. Only then does an Onan production run qualify for Performance Certification.

Buy *proven performance* when you buy an Electric Plant. See your authorized Onan distributor or dealer. You can depend on him for a lifetime of factory parts and service. He's listed in the Yellow Pages.

ONLY ONAN GIVES YOU THIS CERTIFICATION

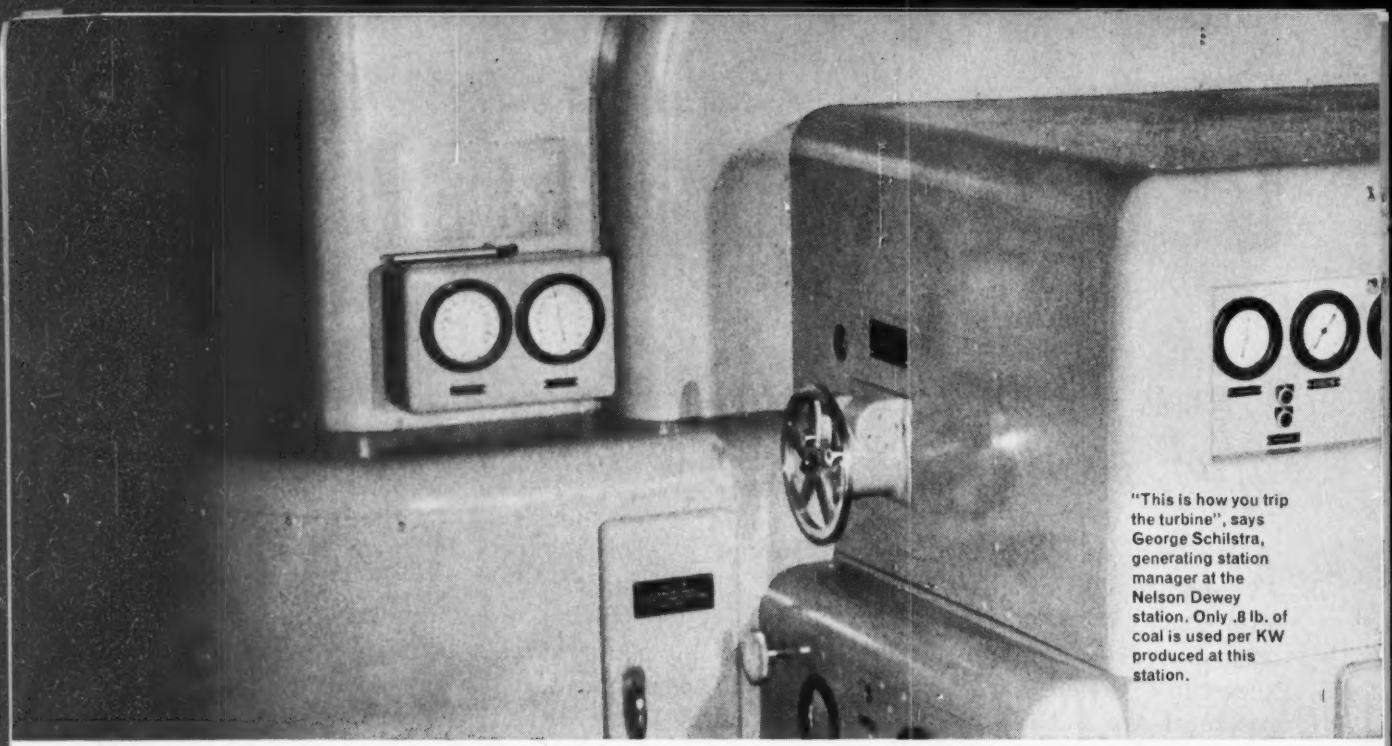
Onan
Onan
PERFORMANCE CERTIFIED
We certify that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.

World's Leading Builder of Electric Power Plants

ONAN DIVISION, STUDEBAKER-PACKARD CORPORATION • 2685 UNIVERSITY AVE. S. E., MINNEAPOLIS 14, MINNESOTA

For more facts circle 212 on Reader Service card, p 99

Circle 213 on Reader Service card for following ad ➤



"This is how you trip the turbine", says George Schilstra, generating station manager at the Nelson Dewey station. Only .8 lb. of coal is used per KW produced at this station.

BY R. C. "ROLLY" BLEIMEHL

About the Author. Rolly Bleimehl has been providing technical service on lubrication to customers of our parent company for fifteen years. He has a mechanical engineering degree from Iowa State College and has completed the Company's Sales Engineering School at Whiting, Indiana.

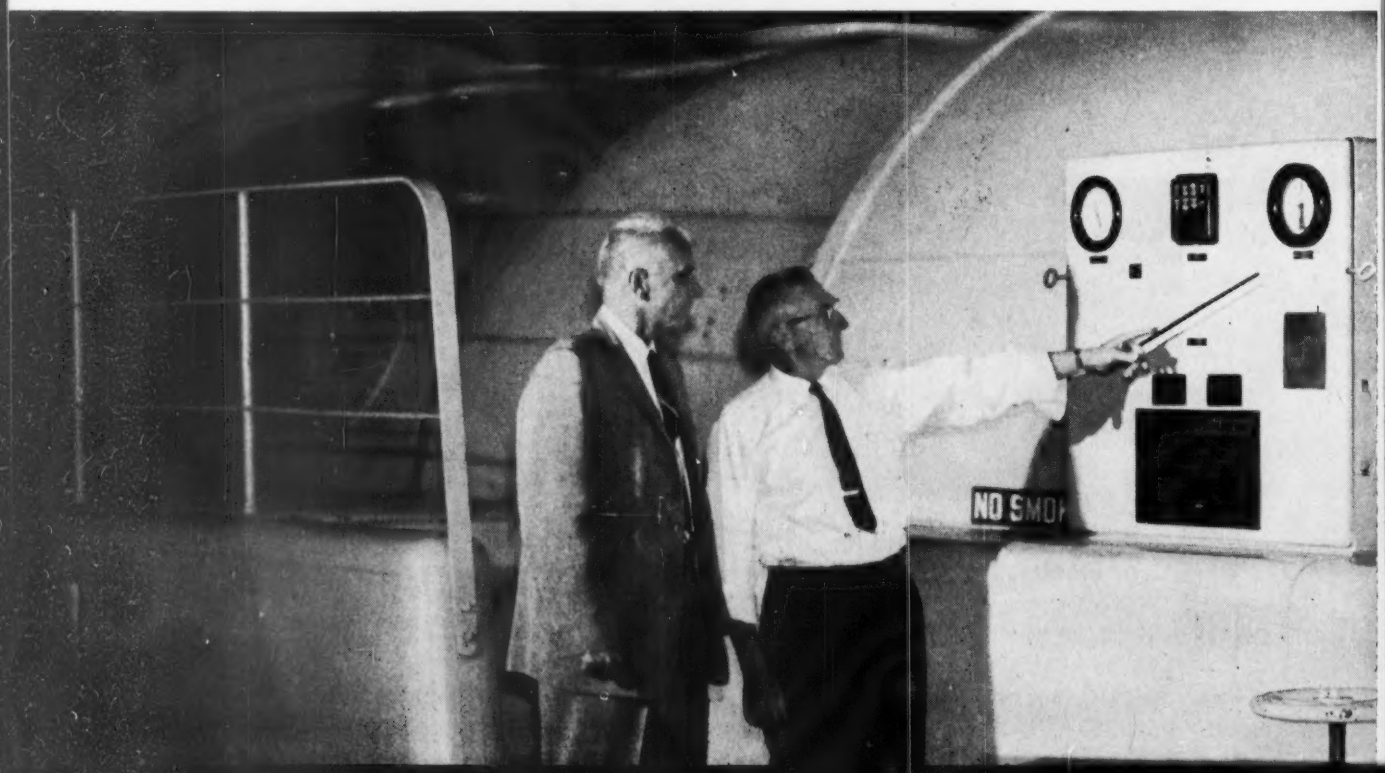
★ ★ ★

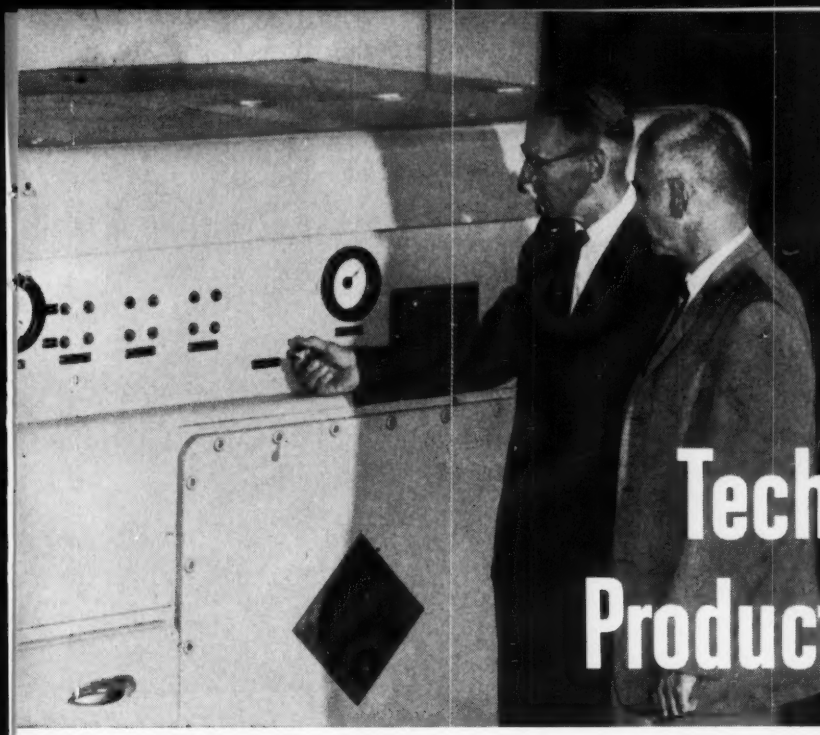
In 1954, when the first of two 75,000 KW turbines went into service at Wisconsin Power & Light Company Rock River generating station, Beloit, management had to make a decision on a turbine oil. Two factors helped them decide in favor of NONPAREIL Turbine Oil: (1) NONPAREIL's performance history and (2) the technical service available from American Oil Company.

Performance history: Each fill of NONPAREIL Turbine Oil carries with it a life-of-turbine guarantee. This means that if, during the life of the turbine, the neutralization number of the oil ever rises above the low limit of 0.15, the oil will be replaced free of charge. Some fills of NONPAREIL Oil have been in service more than 35 years under this life-of-turbine guarantee.

Technical service: I'm located at Madison, only a short distance from Beloit. Thus, I'm always handy to make periodic calls at the station to answer questions about the oil. And we take samples of the oil regularly for analysis at our Whiting, Indiana, laboratory (at no expense to the utility).

Putting these two together—product performance and technical service—Wisconsin Power & Light Company decided it made good sense to specify NONPAREIL Turbine Oil. The satisfactory performance of the oil in the first turbine at Beloit helped the management decide on





This is
AMERICAN OIL COMPANY
in action

Technical Service, Product Performance

it for the second 75,000 KW unit when it was installed in 1955. For the same reason management selected NONPAREIL when their 100,000 KW turbine went into service at the Nelson Dewey station, Cassville, Wisconsin, in 1959.

Get more information about NONPAREIL Turbine Oil and about the lubrication technical service that is available. Phone your nearby American Oil Company office.

Quick facts about **NONPAREIL Turbine Oil**

- Will not permit formation of harmful acids.
- Will not permit formation of sludge or oil varnish.
- Will maintain good demulsibility or water-separating characteristics.
- Has high resistance to foaming.
- Contains adequate rust inhibitor.

AMERICAN

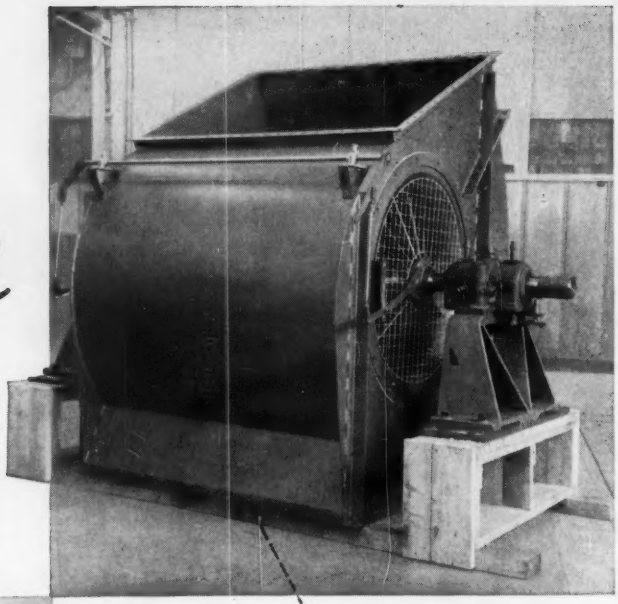
AMERICAN OIL COMPANY
910 S. Michigan Ave., Chicago 80, Ill.

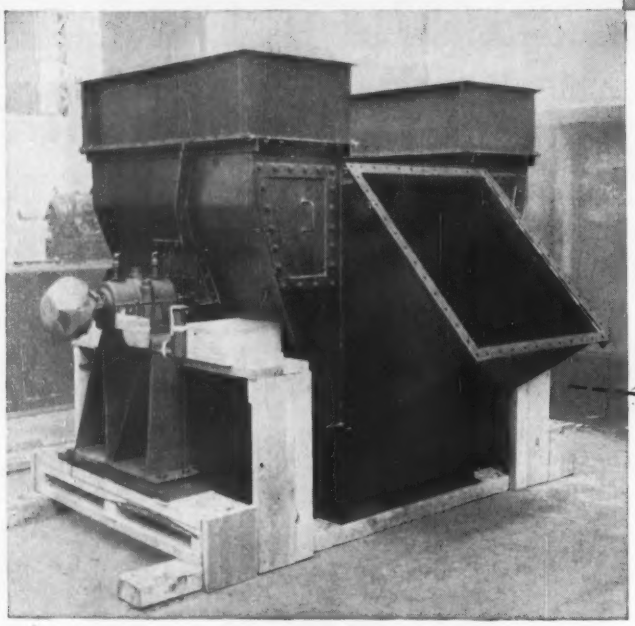
--two reasons why this utility selected

NONPAREIL Turbine Oil

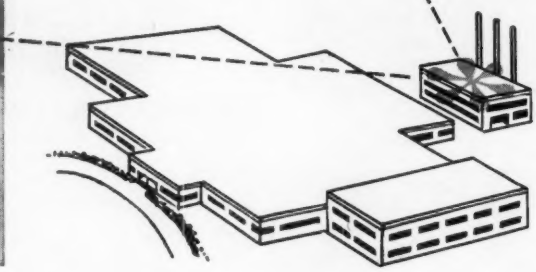
Leslie Hoffman (right), Rock River generating station manager, goes on an inspection tour of one of two 75,000 KW turbines with American Oil's Rolly Bleimehl. Rock River is the largest station in Wisconsin Power & Light Company system.

Headed for another tough job





...this mechanical draft "team" of top performers from CLARAGE



FOR FORCED DRAFT... FOR INDUCED DRAFT... AGAIN CLARAGE QUALITY IS THE CHOICE! These Clarage units, pictured on the shipping dock, will soon be in service at one of the nation's leading paper mills.

At the top is the Clarage Type AF Dynafoil forced draft fan with airfoil blades and Vortex Controls at the inlets; below is the Clarage Type DN Dynacurve induced draft fan with 36 forward curved blades. Clarage equipment, such as this combination, has been selected for over 4,500 central stations and industrial power plants. These users know that with anything as vital as uninterrupted operation, it pays big dividends to get the best in equipment—Clarage.

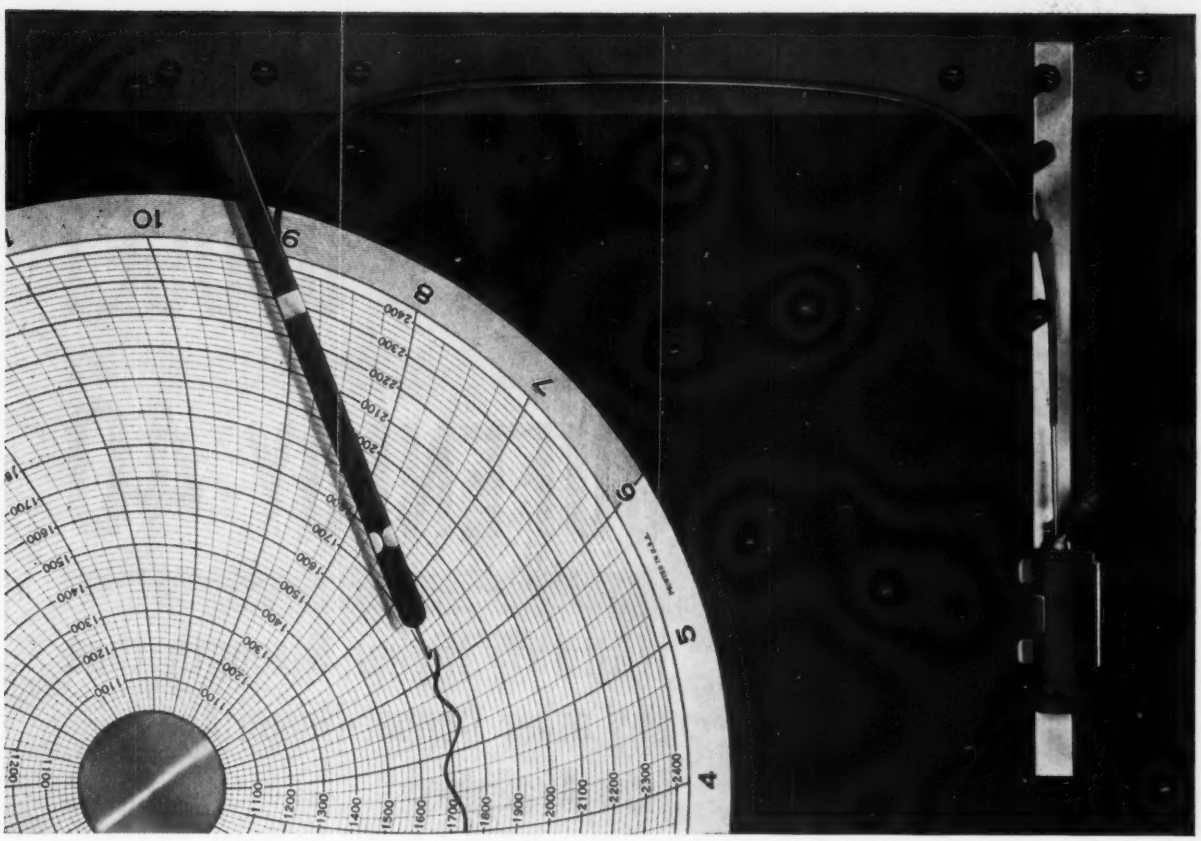
For complete information, request Catalog 905 on the Type DN, Catalog 859 on the Type AF, and Catalog 901 on the Type RT induced draft fan.

Dependable equipment for making air your servant

CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



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NEW MARK-TROL*

eliminates 95% of the mess and maintenance of round chart recorder inking systems . . .

In 10 minutes, convert present markers with Mark-Trol, a completely sealed capillary system with replaceable ink cartridge . . . adaptable to 90% of all round chart recorders in service today.

Esterbrook's Mark-Trol is a completely new concept in marking systems. Because of its universal design, you can eliminate the messy problems inherent in most round chart inking systems in use today. Because maintenance is reduced to little more than routine inspection, Mark-Trol will pay for itself in a matter of days.

Sealed system eliminates dust, dirt, moisture and mold which clogs open-bucket devices. Operation is thoroughly efficient regardless of location, inside or out, under service conditions of humidity, precipitation, chemical fumes or other foreign matter, and over a wider temperature range —0°F to 145°F. Slip-in, disposable, sealed ink cartridge means ink is never directly handled . . . no messy suction tubes, syringes, droppers; no reservoirs to clean out. Eliminates breakage of plastic bags or glass devices. The cartridge contains a large supply of ink, extending your change cycle from days to months . . . and then in a matter of seconds the cartridge is replaced.

ORDER ONE FOR TRIAL—Mark-Trol has been field-tested for 2½ years—extensively in the power and processing fields. We invite you, however, to make a trial installation of your own with a Mark-Trol unit. Send us the coupon today.

Authorized Distributor:

Technical Recording Chart Division
Graphic Controls Corporation
189 Van Rensselaer St., Buffalo 10, New York

Please send us..... Mark-Trol Conversion Kits at $12.00 each.

Name..... Title.....

Company.....

Address.....

Please also send literature completely describing Mark-Trol. ☐

*Trademark

MARK-TROL **THE ESTERBROOK PEN COMPANY** • Technical Products and Instruments Division

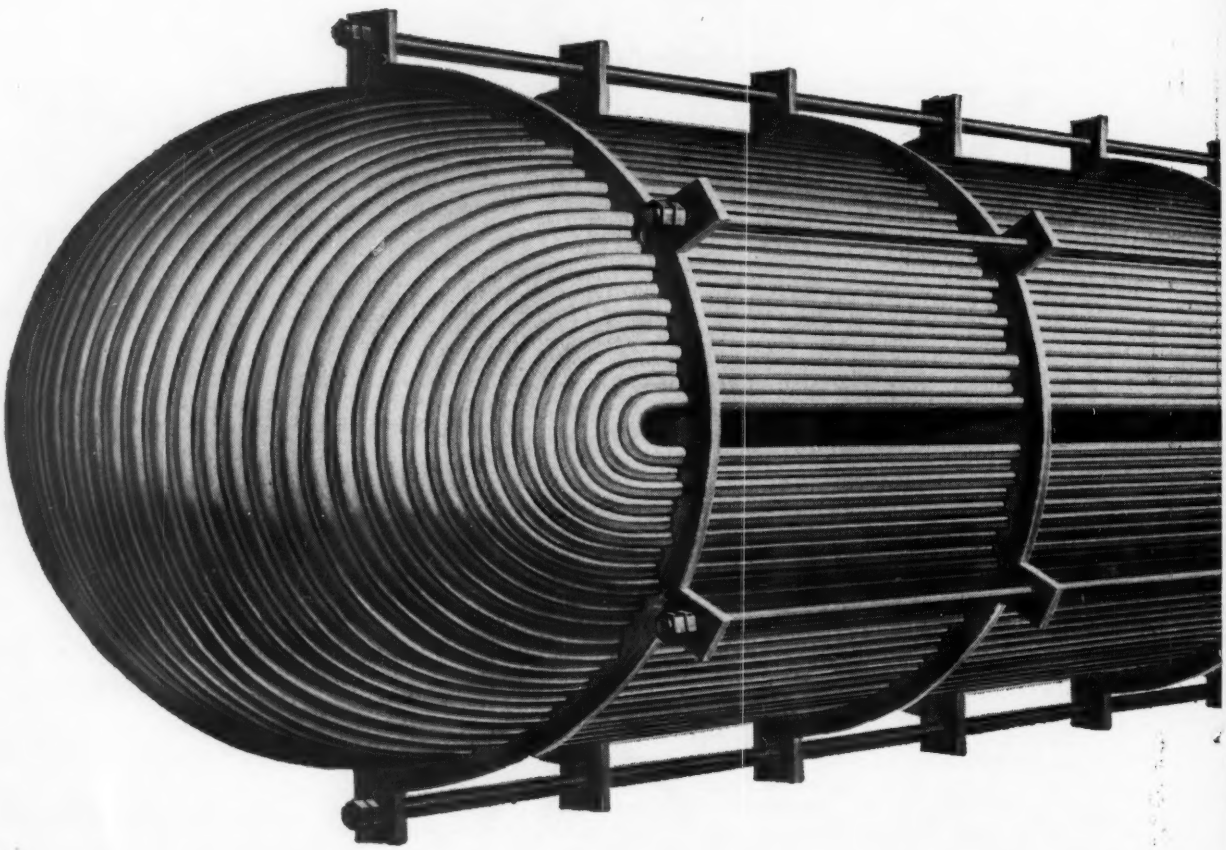
For more facts circle 215 on Reader Service card, p 99

Another New Extra High Strength
Condenser Tube Developed by

PHELPS DODGE!

CUFENLOY-40

With 15% Higher Strength than
any other Copper-Nickel Alloy
Now Available!



In August 1959, Phelps Dodge introduced the first high strength copper-nickel alloy condenser tube, Cufenloy-30. Now Phelps Dodge offers Cufenloy-40, a copper-nickel alloy with greatly increased strength suitable for the most severe applications in high pressure feedwater heaters. The mechanical and physical properties of this exclusive new alloy make possible substantial reductions in the cost of feedwater heaters. Cufenloy-40 has received approval for ASME Code applications through Case 1300 (Special Ruling).

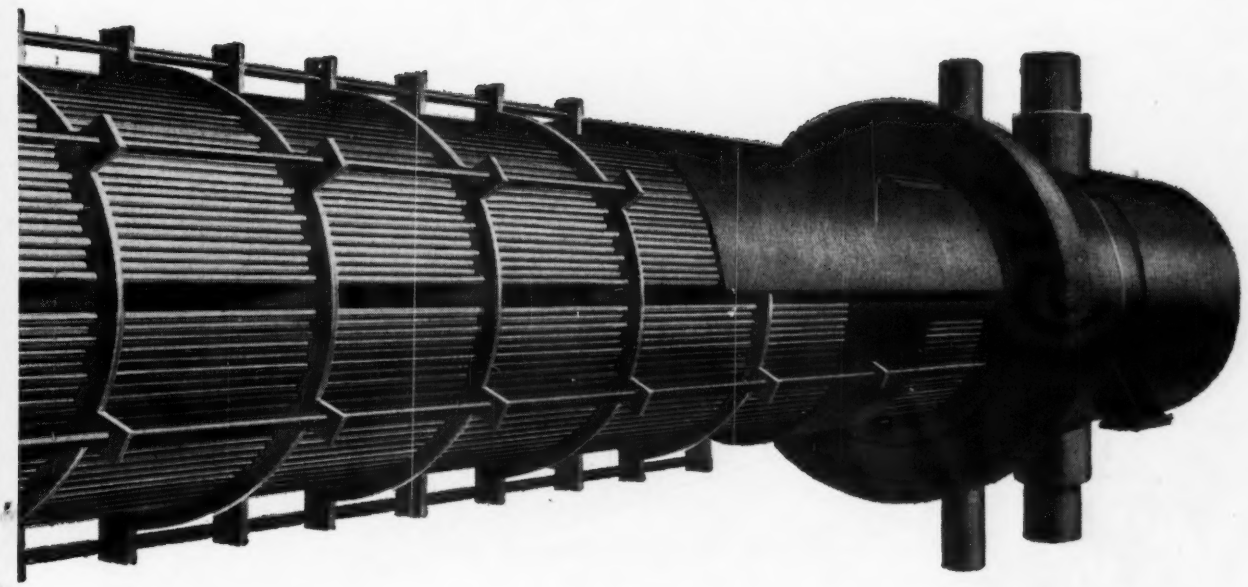
Weldability. Extensive tests in Phelps Dodge's laboratories were performed to determine Cufenloy-40's welding characteristics. Standard welding procedures used for 70/30 copper nickel tubes were found to be fully acceptable for this new composition. Pull-out, Cycling and Pressure Tests confirmed that a maximum joint efficiency was obtained using these procedures.

Corrosion Resistance. Corrosion studies have been performed on Cufenloy-40 since 1959 and have shown it to be unsusceptible to stress corrosion cracking in a moist ammonia and carbon dioxide atmosphere. In these tests Cufenloy-40 also proved virtually immune to general chemical attack. It is believed that Cufenloy-40 has the best overall corrosion resistance of the copper-nickel alloys.

Dual Gauge. Cufenloy-40 condenser tubes are available in dual gauges wherever a thickened wall section is needed to compensate for thinning on tight radius bends.

U-Bent Tubes. Cufenloy-40 tubes are also furnished in factory "U" bends for immediate tubing into the unit at the manufacturer's plant or on the job site.

Further Information from your local Phelps Dodge sales office, or write Dept. 2A for the Cufenloy-40 technical brochure.

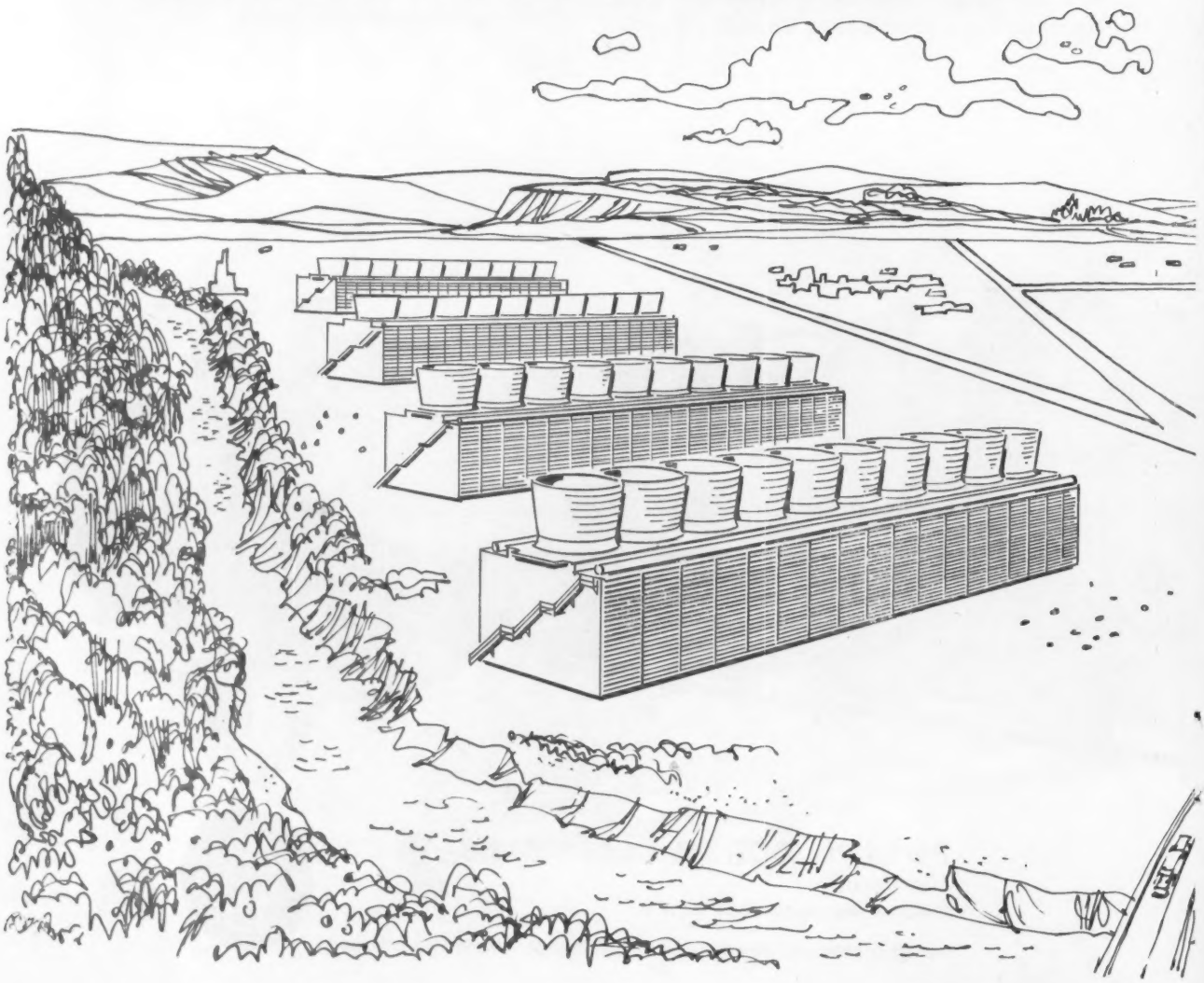


PHELPS DODGE COPPER PRODUCTS
CORPORATION
300 Park Avenue, New York 22, N.Y.

P MINE TO MARKET D

America's most efficient station
is supplied with

WATER* BY MARLEY



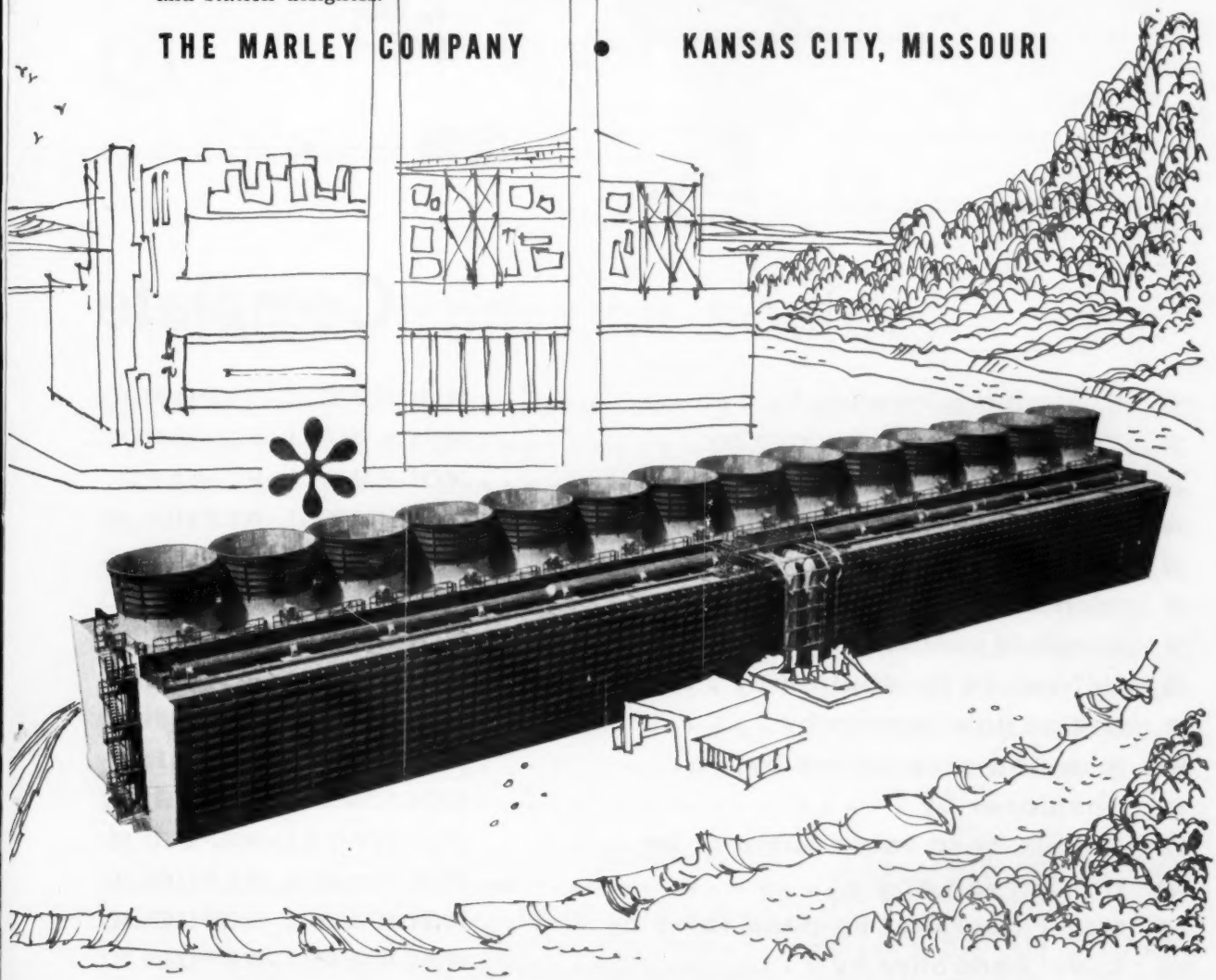
APPALACHIAN POWER'S CLINCH RIVER STATION, according to industry-wide data submitted to the Federal Power Commission, recorded the country's best central station heat rate during 1960. The 8975 Btu per kwh achievement demonstrates the advantage of many factors — location, fuel supply, operation characteristics — that engineers of American Electric Power Service Corporation designed into the plant.

Historically, this rating has gone to stations which obtain their cooling water supply from nature. But this winning station is totally dependent on **WATER * BY MARLEY** — four 10-cell Double-Flow cooling towers were selected by the designers to supply 220,000 gpm for Units 1 and 2 with 450-MW nameplate capacity. The performance of these Double-Flows complimented the high standard demanded of all equipment in this economy-record station. Moreover, ***it firmly established the concept of freedom of economical site choice afforded by cooling tower usage*** envisioned by the plant designers.

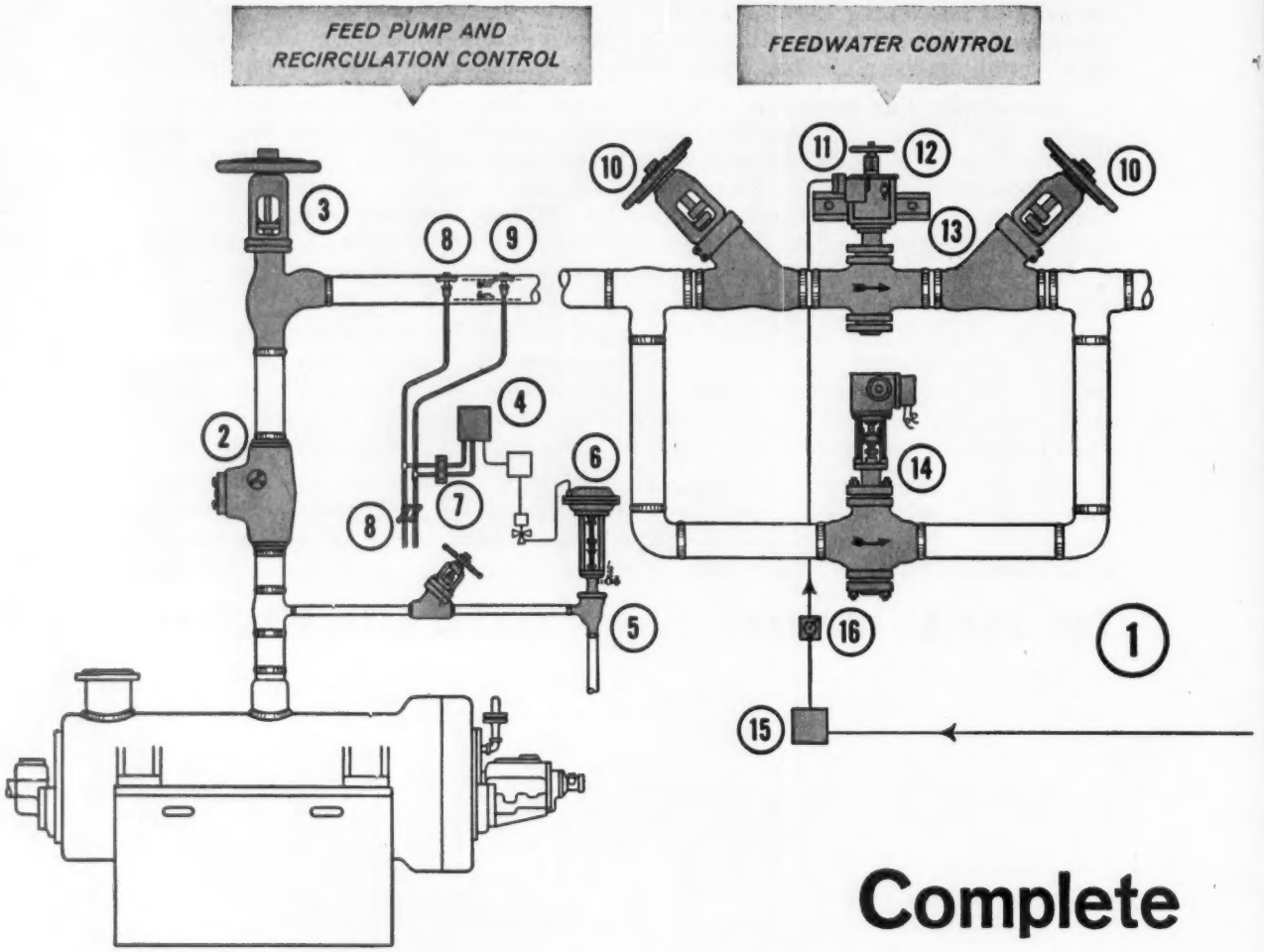
Unit 3 tower is now going on the line to help put another 225 low-cost megawatts into the AEP System. Improving on a good thing, the Unit 3 tower has better features with lower installed cost, more compact area and less auxiliary power. It is the largest capacity, single-unit central station tower ever built, and in parameters of tower engineering, we regard it as the most successful design and value we have known.

The thing that's *new* is the BIGGER PACKAGE . . . providing ***more stamina with fewer big modules*** . . . hence ***lower maintenance and first cost; less power; less space*** . . . all factors that invite thoughtful consideration by all site planners and station designers.

THE MARLEY COMPANY • KANSAS CITY, MISSOURI



Boiler·feedwater

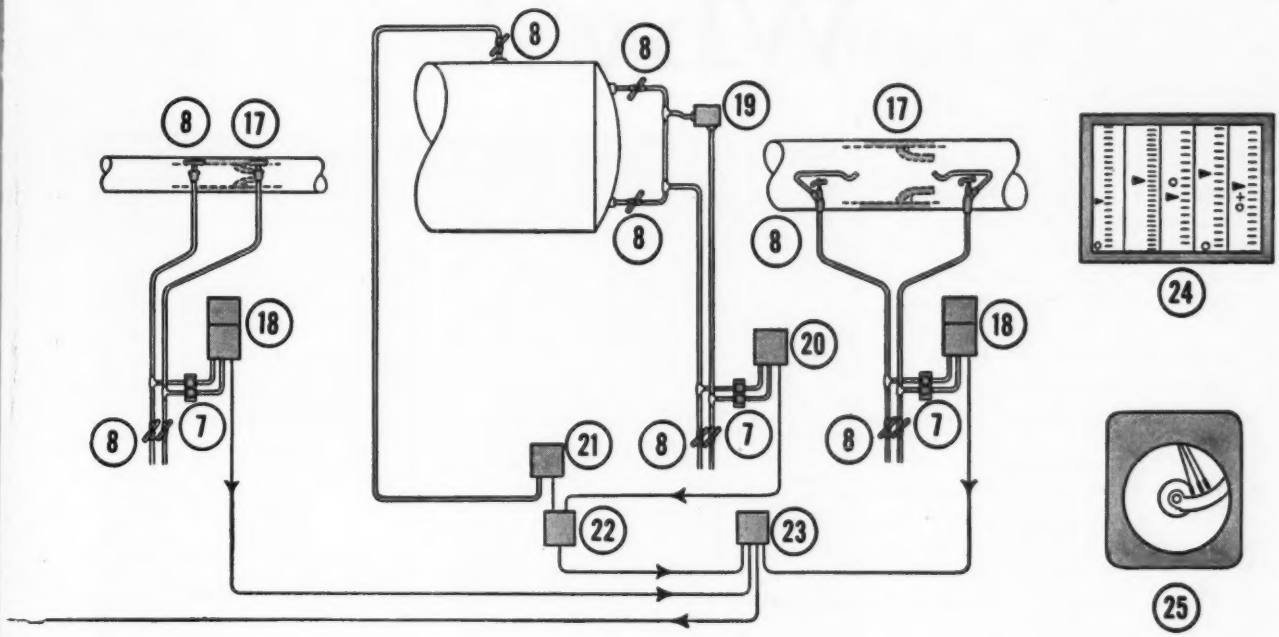


Complete

1	System engineering by	ROCKWELL-REPUBLIC
2	Tilting disk check valve by	ROCKWELL-EDWARD
3	Stop or stop-check valve by	ROCKWELL-EDWARD
4	Transmitter and controller by	ROCKWELL-REPUBLIC
5	By-pass angle valve by	ROCKWELL-REPUBLIC
6	Diaphragm operator by	ROCKWELL-REPUBLIC
7	Manifold valves by	ROCKWELL-REPUBLIC
8	Uni-valves for shut-off by	ROCKWELL-EDWARD
9	Orifice flow section by	ROCKWELL-REPUBLIC
10	Flite-flow stop valves by	ROCKWELL-EDWARD
11	Positioner by	ROCKWELL-REPUBLIC
12	Toggle head valve operator by	ROCKWELL-REPUBLIC
13	Control valve by	ROCKWELL-REPUBLIC
14	Motor-operated by-pass valve by	ROCKWELL-REPUBLIC
15	Level controller by	ROCKWELL-REPUBLIC

control system

FEEDWATER MEASUREMENT | *TEMPERATURE COMPENSATED DRUM LEVEL MEASUREMENT* | *STEAM FLOW MEASUREMENT* | *INDICATING AND RECORDING WHERE REQ'D*



package from one source:

16	Manual-automatic control station by	ROCKWELL-REPUBLIC
17	Nozzle flow sections by	ROCKWELL-REPUBLIC
18	Flow transmitter with square rooting by . .	ROCKWELL-REPUBLIC
19	Constant level reservoir by	ROCKWELL-REPUBLIC
20	Level transmitter by	ROCKWELL-REPUBLIC
21	Pressure transmitter by	ROCKWELL-REPUBLIC
22	Compensating relay by	ROCKWELL-REPUBLIC
23	Combining relay by	ROCKWELL-REPUBLIC
24	Gauges by	ROCKWELL-REPUBLIC
25	Recorders by	ROCKWELL-REPUBLIC

RF-24

For full details on Rockwell-Republic boiler feedwater control systems, contact the Republic Engineer in your area. Or, write to Republic Flow Meters Company, Subsidiary of Rockwell Manufacturing Company, 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada Ltd., Toronto.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

Why?

Why do some steel tubes fail under high operating temperatures and pressures?

Basically, it's because the grade of steel and physical and mechanical properties of the tube haven't been matched accurately to specific stress and temperature requirements. As a result, the tube lacks the mechanical strength to resist rupture and creep in continued service.

There is no formula that will produce automatically the right tube for your application. To arrive at a *Job-Matched* tube requires the knowledge of how particular grades of stainless, alloy and carbon steel tubing react under a variety of specific operating temperatures and pressures. And, it takes engineering know-how to determine the proper factors of oxidation and corrosion resistance, tube size, flow rates, and rates of thermal expansion and conductivity that match application requirements.

This is the kind of experience and assistance available to you through your B&W district salesman or Steel Service Center handling B&W Tubular Products. Why not take advantage of it?

The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

B&W THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-1007P

Seamless and welded tubular products, solid extrusions, rolled rings, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

Here's a vertical turbine with

TERRY SOLID WHEEL

and all its advantages

When it comes to judging a turbine's ability to deliver in vertical service, ratings tell only half the story. It's the Terry construction refinements that give you assurance of long-range operational economy: Thrust bearing designed to absorb external pump thrusts ... carbon ring glands specially made for vertical operation ... casings and bearing housings split vertically for easy accessibility.

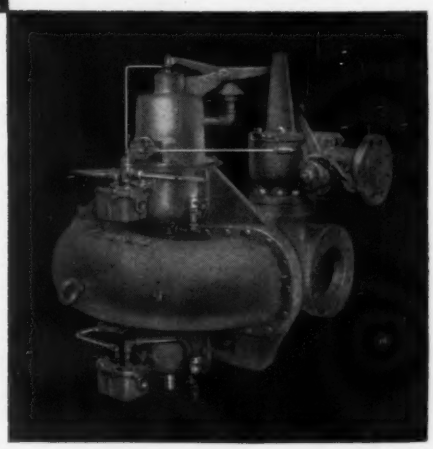
But most important, the Terry vertical turbine has an *almost* indestructible rotor. A single forging of special composition steel, it has no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

If your application demands a vertical turbine, specify Terry solid wheel. Available in capacities from 5 to 300 horsepower. And remember, the extra durability built into these vertical turbines is typical of every turbine in the complete Terry line.

For further information, send for a copy of bulletin S-137.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



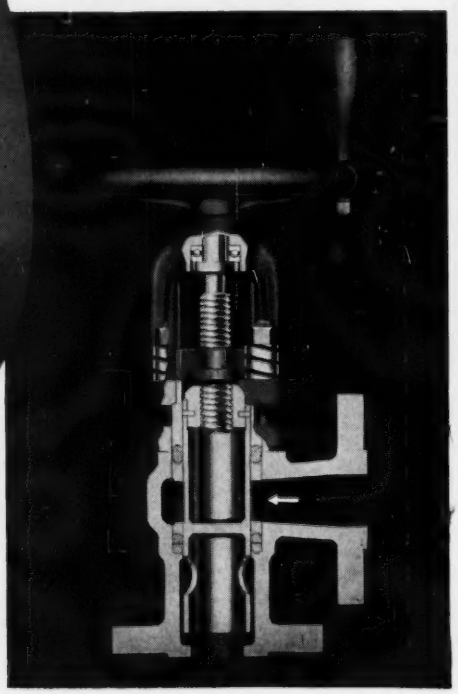
For more facts circle 220 on Reader Service card, p 99

why over

Flanged connection, Yarway Seatless Blow-Off Valve, angle design.

▲ *Yarway Seatless Blow-Off Valve in open position. Note full, free discharge.*

▼ *Valve in closed position. Note tight shut-off.*



16,000 engineers choose and use YARWAY SEATLESS boiler blow-off valves

■ SAVING IN MAINTENANCE COSTS
■ FREEDOM FROM BOILER OUTAGES

These are the reasons—proved again and again by engineers who know *performance*, in thousands of installations over the last 50 years. Yes, these are the reasons why *Yarway Seatless* has become virtually the "standard" on all low to medium pressure boilers today!

Check these features that are responsible for the acceptance of these time-honored but truly modern, compact valves:

■ **UNIQUE SEATLESS DESIGN** — full, free discharge . . . combined with drop-tight shutoff . . . and no seat to score, wear, clog or leak.

■ **BALANCED HOLLOW SLIDING PLUNGER** —made of nitralloy with a "glass hard" surface that resists erosion, high temperatures and sudden shocks. "Polishing" action lengthens life of packing rings.

■ **COMPRESSION YOKE SPRINGS** — heavy coil springs under yoke nuts maintain continuous pressure on reinforced packing above and below valve port to keep valve tight.

■ **BALL BEARING HANDWHEEL**—for smooth operation, easy opening and closing.

■ **NON-RISING STEM.** Valve cannot be opened or closed too quickly. Water hammer is prevented.

■ **STREAMLINED BODY AND YOKE.** Strength where strength is needed—without unnecessary bulk. "Compact" over-all design.

■ **CHOICE OF FIVE SIZES—1″ to 2½″,** angle or straightway designs, flanged or screwed ends, available in any tandem combination.

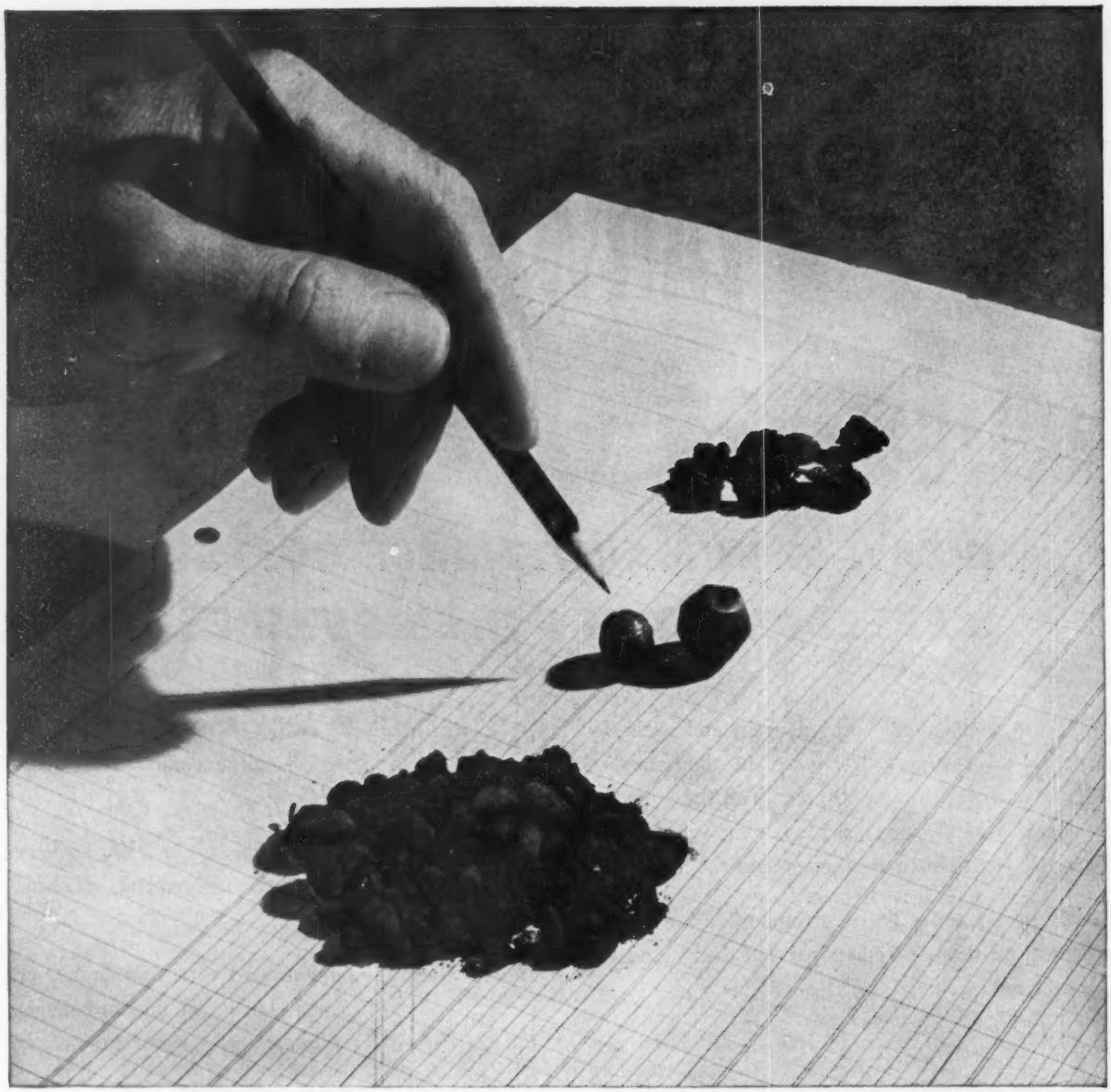
If you are planning purchase of a new boiler, or modernization of present boilers in pressure ranges up to 415 psi, *insist* on protecting your investment with new Yarway Seatless Blow-Off Valves.

They'll give you maximum dependability, minimum maintenance, and satisfaction that is beyond price—all at a very *low* cost per year.

Write for Yarway Bulletin B-427.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING



Specimens of copper powders, balls and balled sheets which can be removed from high-pressure boilers by the M-71 treatment.

M-71 REMOVES THESE COPPER TROUBLEMAKERS FROM BOILERS, FAST!

The M-71 single-stage, patented treatment* for high-pressure boilers removes copper deposits and other scales in record time. With this exclusive Dow Industrial Service treatment, copper does *not replate* on clean boiler surfaces during treatment, and small quantities of M-71 in future cleaning will help *keep* boilers copper-free. To date, the M-71 treatment has cleaned more than 300 boilers.

Copper deposits, common in many high-pressure boilers, reduce heat transfer efficiency and cause localized corrosion, overheating and subsequent ruptures. Copper particles slough off, reducing circulation.

Dow Industrial Service developed the M-71 treatment to remove trouble-making copper and other deposits at the same time. In cases of excessive metallic copper deposits, a preliminary treatment may be desirable.

D.I.S. cleans all kinds of equipment . . . boilers, process equipment, pipelines, water wells, to name a few . . . for every kind of industry. With many methods to choose from, D.I.S. engineers first analyze each job to pick the technique best suited to the specific problem.

D.I.S. also offers complete consulting laboratory service for water treatment and waste processing, backed by the technical resources of The Dow Chemical Company. For fast "total" cleaning of any industrial equipment, anywhere in the U.S.—and for literature on copper removal by the M-71 treatment—write or call DOW INDUSTRIAL SERVICE, 20575 Center Ridge Road, Cleveland 16, Ohio.

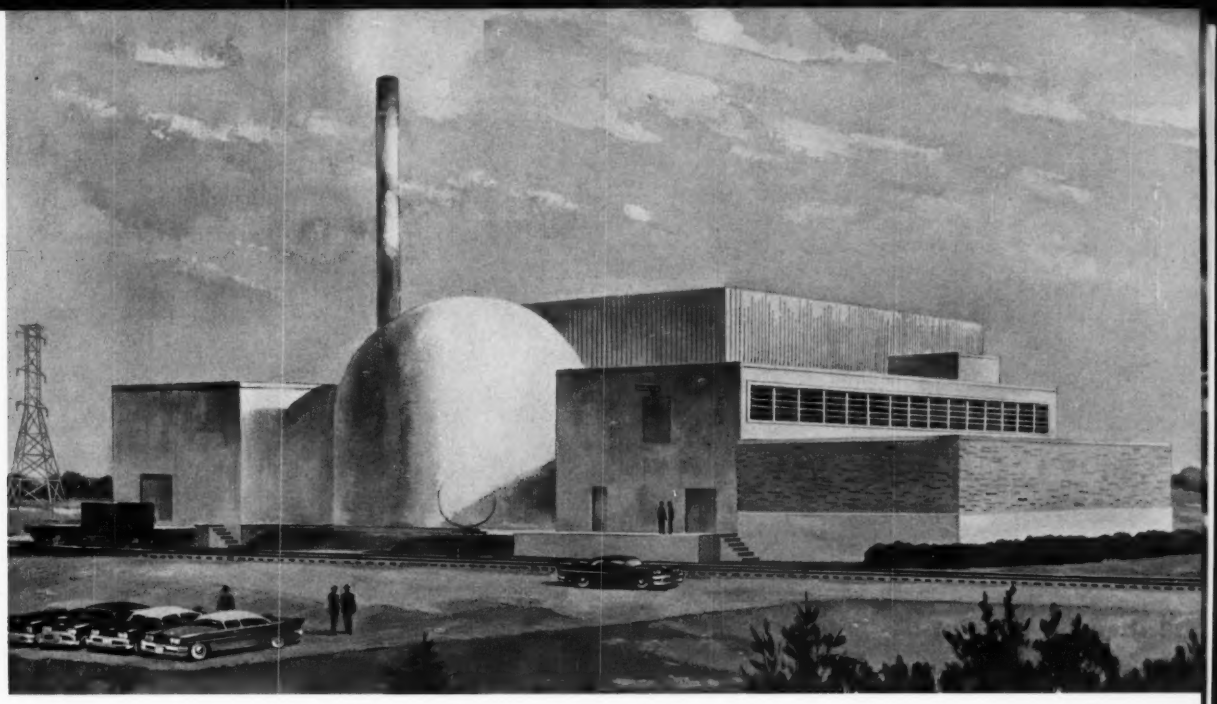
*Patent No. 2959555

DOW

DOW INDUSTRIAL SERVICE • Division of The Dow Chemical Company

For more facts circle 222 on Reader Service card, p 99

circle 223 on Reader Service card, p 99 ➤



49 miles of Wolverine Condenser Tube used in New Pathfinder Atomic Power Plant

Forty-nine miles of admiralty condenser tube produced by Wolverine Tube Division of Calumet & Hecla, Inc. will contribute to the development of electric power when the Pathfinder Atomic Power Plant goes into operation in 1962.

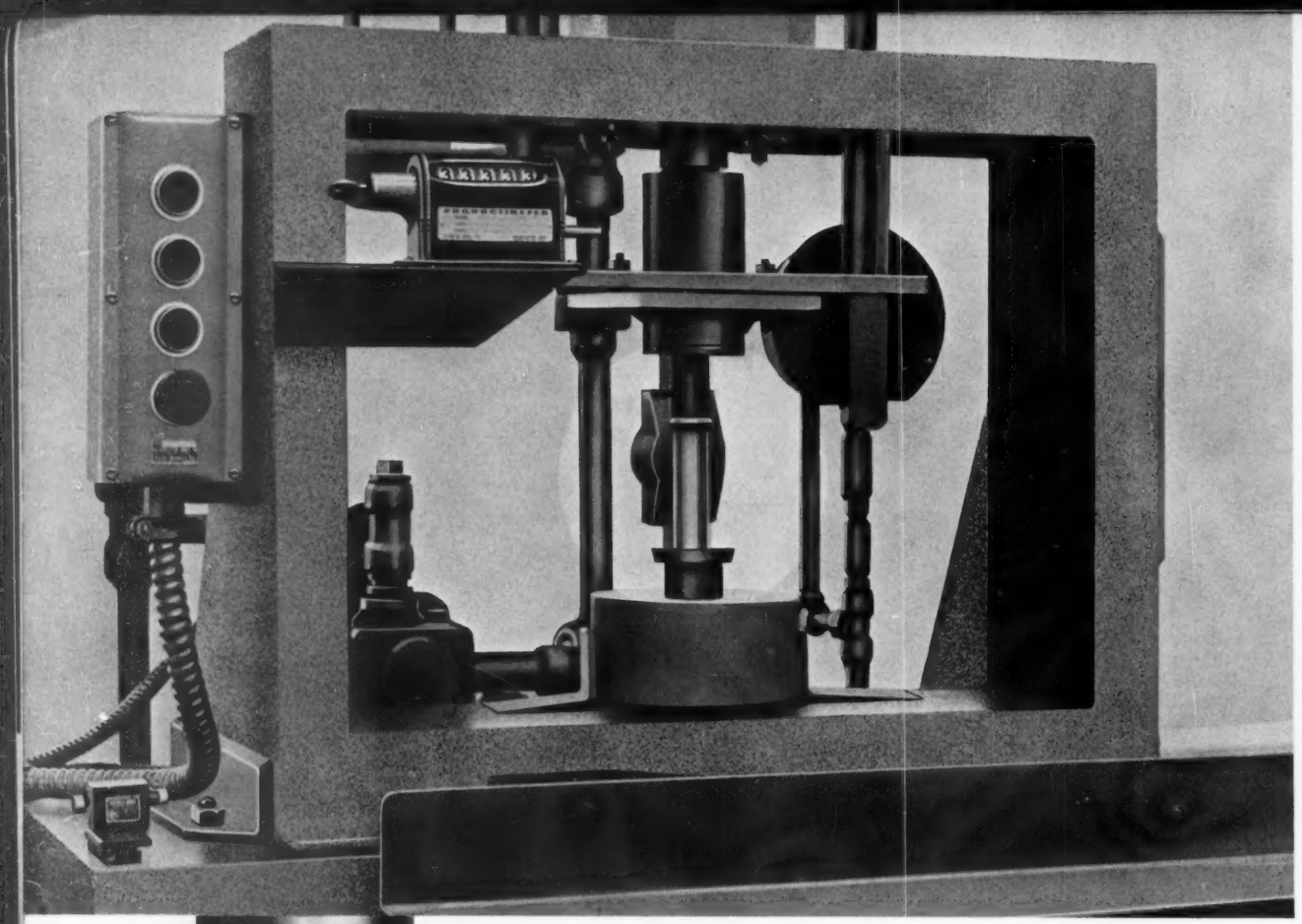
Owned and operated by Northern States Power Company, Minneapolis, Minnesota, the 66,000 KW Pathfinder is the second of America's great new atomic power plants to use condenser tube manufactured by Wolverine Tube. The Enrico Fermi Power Plant at Monroe, Michigan also uses Wolverine admiralty condenser tubes.

It is significant indeed that Wolverine condenser tube is being specified for these highly critical atomic power installations. Wolverine's dedication to quality control procedures, its years of tube-making experience and its continuous research and development programs all contribute to the production of tube designed to give top performance at all times.

Wolverine seamless copper and copper alloy condenser tube is available in a wide range of sizes in both prime surface and integrally finned form. If your company is considering tube for feed-water heaters, surface condensers or air pre-heaters, get a Wolverine quote before placing your next order. Write too, for complete information.

WOLVERINE TUBE
DIVISION OF
Calumet & Hecla, Inc.
DEPT. S, 17268 SOUTHFIELD RD., ALLEN PARK, MICH.
TUBEMANSHIP in Copper—Copper Alloys—Aluminum—Special Metals

PLANTS IN DETROIT AND INKSTER, MICHIGAN AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES



Wolverine Condenser Tubes are COUPON tested

At Wolverine Tube a "coupon" is a sample of tubing cut from *every* length of nonferrous condenser tube. These samples are then put through a mechanical expansion test to prove conclusively that the tubing will withstand rolling-in operations without cracking or splitting.

This is but one of the many steps taken by Wolverine Tube to insure that its condenser tubing will give maximum service under the most rugged operating conditions. Each tube also undergoes a hydrostatic test and, throughout the entire manufacturing process, rigid quality control standards are in effect.

Wolverine condenser tubes are available in a wide range of sizes in copper and aluminum alloys in prime surface or with integral fins (Wolverine Trufin®). You can also specify both plain and finned duplex and U-bend condenser tubes.

Over the years Wolverine Tube has specialized in heat transfer – has both the tubing and experience to help you obtain maximum value for your tubing dollar. Before placing your next order, talk over your requirements with your Wolverine sales representative. He can help you do a better job.

WOLVERINE TUBE
DIVISION OF
Calumet & Hecla, Inc.
DEPT. S, 17268 SOUTHFIELD RD., ALLEN PARK, MICH.
TUBEMANSHIP in Copper—Copper Alloys—Aluminum—Special Metals

PLANTS IN DETROIT AND INKSTER, MICHIGAN AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES

Edmund J. Haar, Chief Engineer of Compressor Plant, Thatcher Glass Mfg. Co., Streator, Illinois, and his new FM-2 compressor.

When you bank on compressed air...

Take a look at an operation that *really* depends on air. At Thatcher Glass Manufacturing Co., Streator, Illinois, compressed air plays vital roles. It supplies process air for glass blowing. It powers practically all of their expensive machines and handling equipment. Reliable air pressure is a *must.*

In a recent expansion of its compressed air plant, Thatcher decided on the new Cooper-Bessemer 600 hp FM-2 compressor shown above. This is one of the fine quality M-Line Series featuring "natural force balance" and recognized everywhere for dependable, low-maintenance performance.

Whatever you make . . . when you want compressed air for processing or power, it will pay you to investigate the Cooper-Bessemer M-Line Compressors. Call our nearest office.

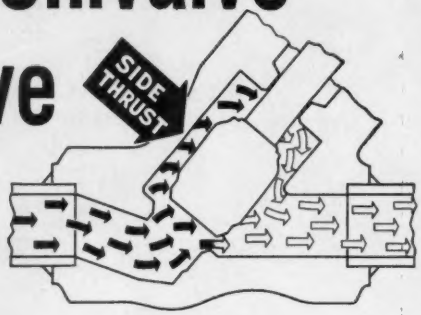
Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINES: GAS - DIESEL - DUAL-FUEL
JET-POWERED GAS TURBINES

For more facts circle 224 on Reader Service card, p 99

New Rockwell-Edward Univalve* design solves globe valve side thrust problems



Major causes of disk-seat misalignment, stem bending, galling, and related problems eliminated in new forged steel Univalve line.

Now, through a unique body-guided disk construction, Rockwell-Edward research engineers have solved the major globe valve problems inherent in modern high-energy-loss piping systems.

High velocities and high pressure-differentials have a damaging effect on forged steel globe valves in throttling, blow-off, drain and similar services. Conventional stem-guided disks are forced out of alignment and don't seat positively. The same forces bend even the strongest stems out of alignment. Contact areas on disk, seat, disk-nut, stem and bonnet become galled and scored.

But now these problems have been overcome by the new Rockwell-Edward Univalves. And other perennial problems have been solved at the same time.

Here's how new Univalves solve major problems

1 **Body-Guided Disk.** Heart of the new Univalve is its revolutionary new body-guided disk with Stellite anti-thrust rings. Not only does the new design and construction do a perfect job of guiding the disk into the seat but, even more important, it eliminates as much as 90% of the side thrust that *causes* misalignment!

The close fit of the lower Stellite disk guide ring within the body bore virtually eliminates the problem of upstream-downstream pressure differential that can force the disk and stem out of alignment. Remaining forces that could cause misalignment are easily controlled by the inter-action of the two widely separated guide rings.

Use of Stellite for guiding and contact surfaces provides maximum protection from erosion, galling and oxidation, as well as from scratching and cutting by foreign material in the line. Results: a valve that can be opened and closed repeatedly in high pressure loss services with merely a superficial polishing of contact surfaces.

2 **Improved disk-nut lock.** Instead of merely tack welding the disk to the disk-nut, Edward now employs a more expensive but virtually fool-proof method to keep these parts together. In the new Univalve a hole is drilled through the upper portion of the disk and, after assembly, is filled with weld metal. The bond is permanent, yet disassembly can be accomplished easily by merely drilling out the weld plug.

3 **Special stem surface treatment.** The new Univalves of larger size have stems coated with molybdenum disulfide. This process endows the stem with remarkable lubricating and anti-galling properties. Life of stems and all adjacent parts is extended. Operating torque is reduced.

4 **Easy-to-locate body-bonnet seal-weld.** Extended vertical and horizontal surfaces of both bonnet and body provide clear definition of seal-weld dimensions. This facilitates the machining or scarfing required to remove the weld metal when disassembling the valve.

These and other refinements (like the Stellite backseat contact in many sizes and Stellite stem-disk bearing in all sizes) combine to produce a new Rockwell-Edward Univalve line that is easier to operate and gives maximum valve life.

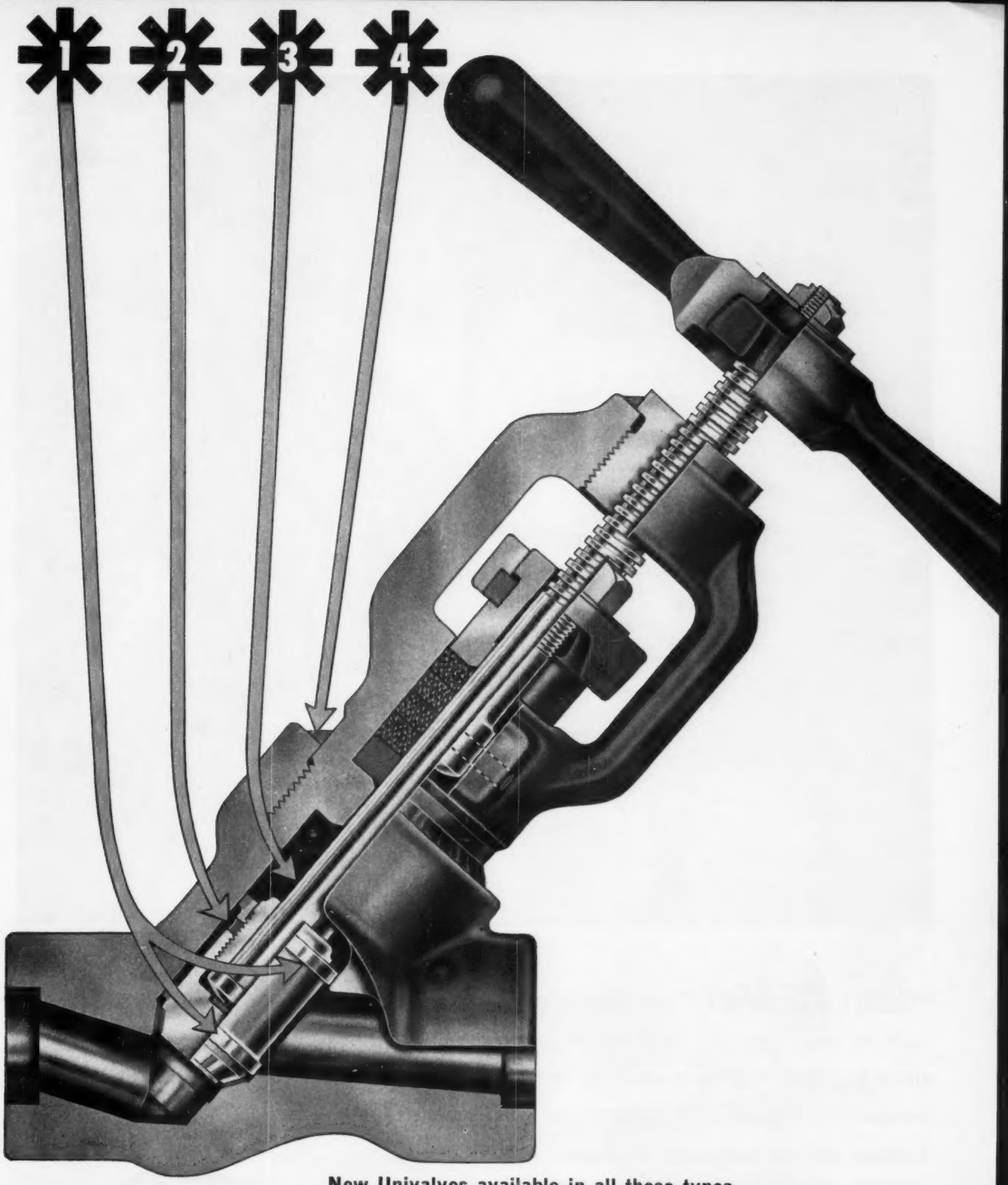
More body styles (see box at right) offer additional advantages. The vertical stem globe design, for example, can readily be installed with its stem projecting through a panel board. Or, it can be used with an extension stem for certain inaccessible locations.

And, where flow requirements are less rigid, the new Univalve line offers the "K" series. These reduced-port valves, available at lower cost than full-port units, provide full Univalve life and ease of operation for applications where flow capacity is secondary to other considerations. "K" series Univalves have flow capacity equal or superior to most similar competitive valves.

The new Rockwell-Edward Univalve line is available with screwed, socket, or butt weld ends, and with your choice of loose or integral backseats. For more detailed information, ask your Edward Representative for a copy of Catalog 14-U, or write Edward Valves, Inc., 1230 W. 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 438 St. Peter Street, Montreal. 6105

*T.M. Reg.
U.S. Pat. Off.

EDWARD STEEL VALVES
another fine product by
ROCKWELL



New Univalves available in all these types

BASIC DATA

Body Material—forged chrome-moly steel
Sizes—½ inch to 4 inches

Basic Ratings—

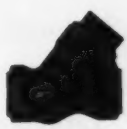
1500 psi at 1050 F (3600 psi at 100 F)
2500 psi at 1050 F (6000 psi at 100 F)
4500 psi at 1050 F (10,800 psi at 100 F)

Vertical or Inclined (Y pattern) Bonnet
Screwed, Socket Weld or Butt Weld Ends

1. Inclined bonnet globe stop (or stop-check).

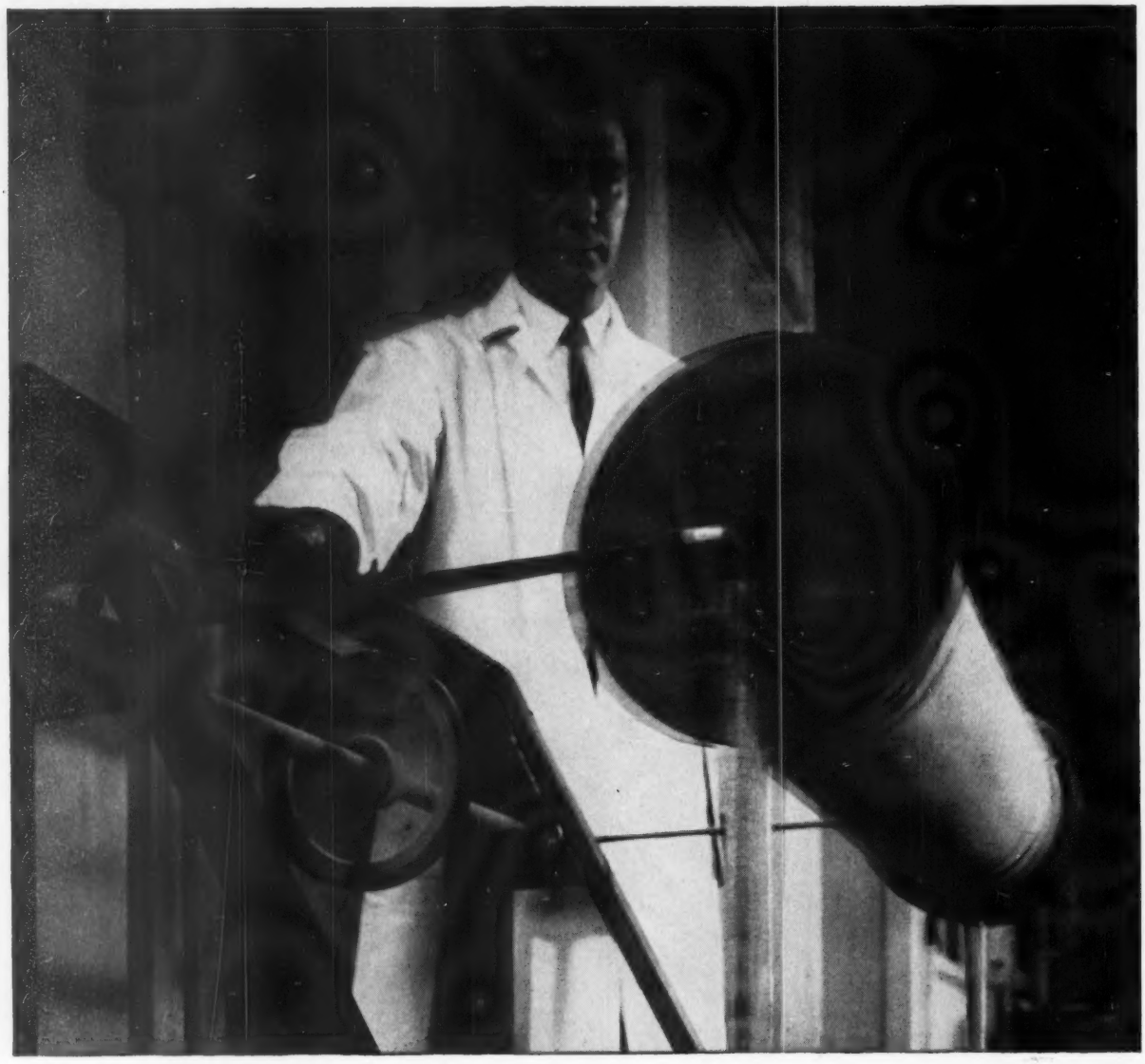
2. Angle body stop

3. Vertical bonnet globe stop



4. Piston check (horizontal or vertical)

For more facts circle 225 on Reader Service card, p 99



"K&M" ZEBRA Pipe Insulation *proves its toughness before it leaves home!* In torture tests by hard-to-satisfy K&M engineers, "K&M" Zebra® proves its ability to withstand heat, shock and vibration. Its multi-layer, sectional-type construction of calcium-silicate—asbestos bonded felts requires no babying on the job. Demonstrates a deflection at breaking point 2 to 4 times that of ordinary insulation. Stands up under periodic removal for line inspection. "K&M"® Zebra Pipe Insulation prevents heat loss indoors and outdoors, through a temperature range from 200 F to 1200 F. Its smooth, dust-free surface facilitates handling (no skin irritations or penetration). Half-sections and sizes available through 24″ pipe diameters. For more information, write: *Keasbey & Mattison Company, Ambler, Pa., Dept. I-1111.*

K·M
BEST IN ASBESTOS

Keasbey & Mattison at Ambler

For more facts circle 226 on Reader Service card, p 99

FIRST PRE-PACKAGED

electric storage water heater for commercial, industrial and institutional use.

The new P-KW is the first electric storage water heater to be offered as a standard package unit. It is shipped fully wired, insulated and factory tested. It requires only electrical and water connections to place in operation.

The new unit is equipped with immersion heater, control thermostat, magnetic contactors, circuit breaker, panel control box, ASME temperature and pressure relief valves, thermometer, pressure gauge, metal jacketed insulation, and integral support skids.

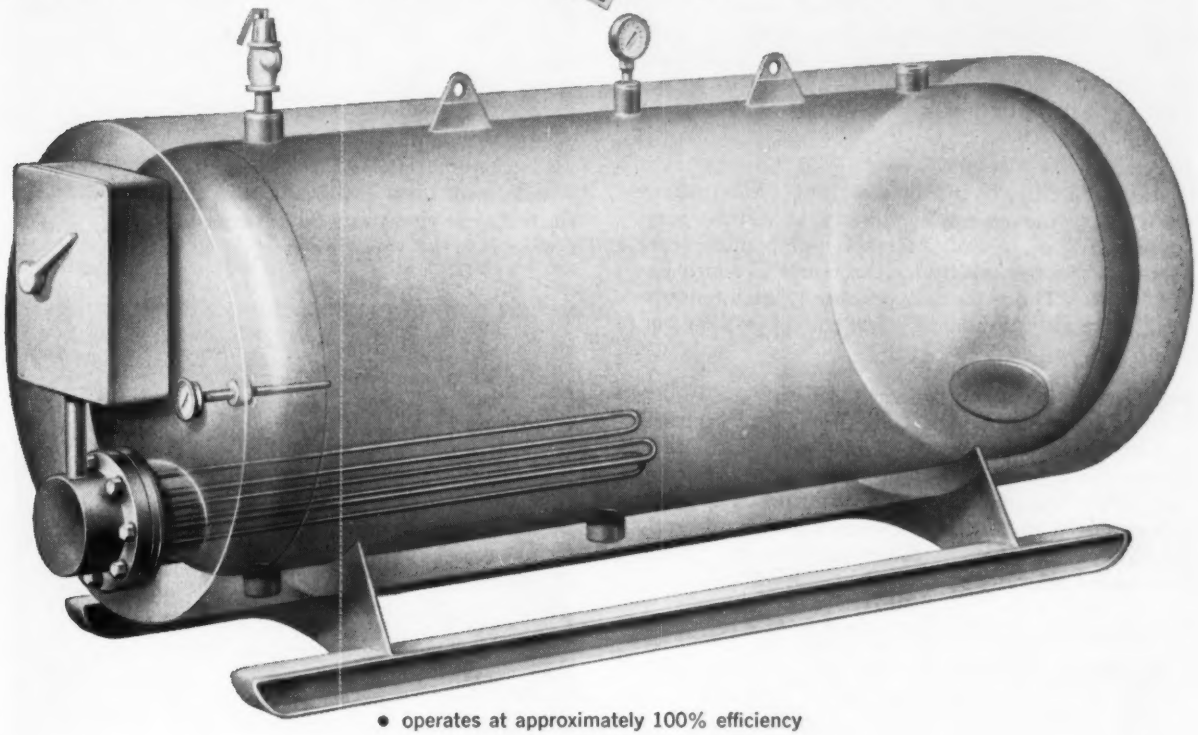
Made by P-K on a custom basis for many years, P-KW Electric Storage Water Heaters are designed and fabricated in accordance with the ASME Code and Federal, State and local regulations.

Components that comprise the electrical system, including wiring, meet the requirements of Nema standards and the National Electrical Code.

The immersion heating elements are operated approximately 10 per cent below their voltage capacity—assuring long, trouble-free service. The thermal conversion approximates 100 per cent efficiency.

Pre-packaged P-KW water heaters can be selected for three working pressures – 100, 125, and 150 psi.

WRITE FOR CATALOG NO. P-KW-1: contains diagrams, specifications, complete engineering and performance data. Address your request to: The Patterson-Kelley Co., Inc., 811 Morgan Avenue, East Stroudsburg, Pa.



- operates at approximately 100% efficiency
- storage capacities from 284 to 1,300 gallons
- recovery capacities from 41 to 410 gph
- horizontal or vertical design
- safe, silent, automatic

Patterson Kelley

How Commonwealth Edison Turned a Fly Ash Problem Into Profit

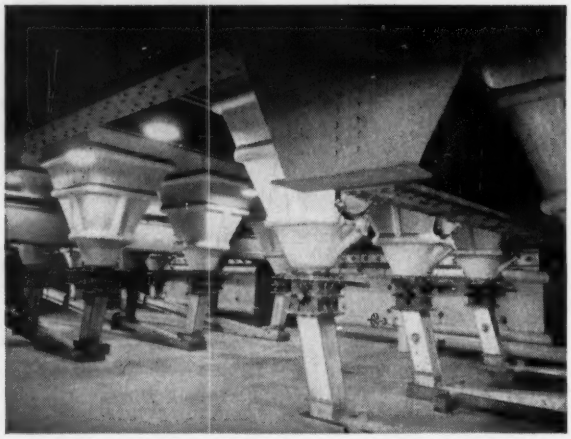
At Commonwealth Edison's State Line Station, about 350 tons of fly ash a day had to be wet down, loaded, and trucked to suitable dumping sites.

Waste becomes profit. Today, the plant burning a peak load of 5000 tons of coal daily collects dry fly ash automatically in a totally enclosed Fuller-Kinyon system. The ash is conveyed from precipitators to storage bins and silos, where it's sold as a by-product. Manpower: just three men, one at the main control panel and two bagging the ash.

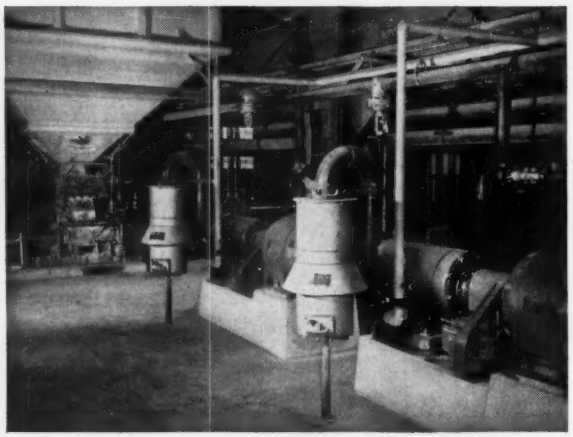
Air and gravity do the work. F-H Airslide® conveyors fluidize dry fly ash by a column of low-pressure air for easy movement by gravity to central surge hoppers. Then, a Fuller-Kinyon pump under each hopper drives the ash by air through a five-inch line to storage. The system is practically maintenance-free. There are few moving parts to foul or wear out.

Large and small plants can get the benefits of Fuller-Kinyon fly ash handling. Capacities range from 100 to 8,000 cubic feet an hour. F-H Airslide and Fuller-Kinyon conveying lines can be curved to avoid beams and other obstacles. Low-pressure air provides power inexpensively and installation costs are significantly less than other types of conveying systems. Write for detailed information in Bulletin FF-49-1.

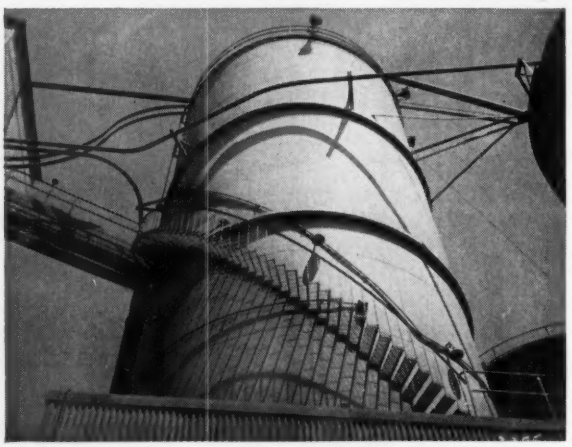
See Chemical Engineering Catalog for details and specifications.



F-H AIRSLIDE FLUIDIZING CONVEYORS ANGLE DOWNWARD from precipitator hoppers, move air-activated ash to 20-ton central surge hoppers under floor. There are few moving parts.



FULLER-KINYON PUMPS AND COMPRESSORS under surge hoppers propel ash to bins and silos at 20 tons an hour. Fluidized by air, the abrasive, 300°F. ash moves without injuring system.



BULK SILOS receive air-conveyed ash through Fuller-Kinyon pipe-lines. Farthest silo is 1,000 feet from pumps. Over 50% of fly ash is bagged and sold as a by-product.

1335A
G-203 A

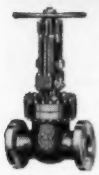
Fuller
...pioneers in harnessing AIR

FULLER COMPANY
126 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Offices in Principal Cities.

FULLER COMPANY GENERAL AMERICAN TRADE MARK

For more facts circle 228 on Reader Service card, p 99

10320-OIC



When valve maintenance costs become excessive, a change in valve type, trim or design is frequently indicated.

Reduce those rising maintenance and production interruption costs. Look to the valve expert on your doorstep. Your experienced OIC distributor, supported by a large field service organization, will advise the use of the correct valve and trim materials designed to protect you from valve failure.

OIC VALVES

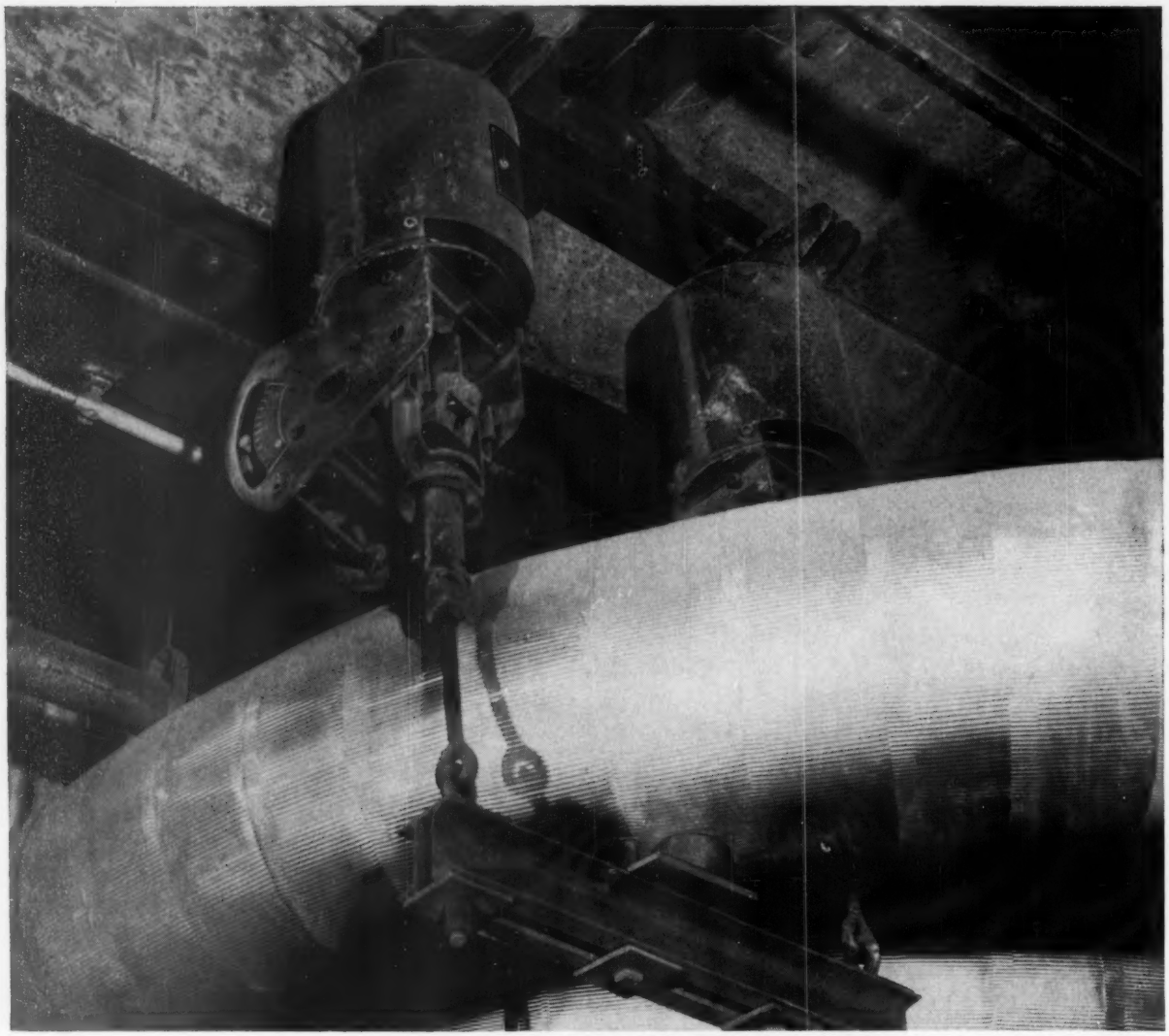
BRONZE, IRON, FORGED STEEL, CAST STEEL AND DUCTILE IRON VALVES.

THE FINEST VALVE AND DISTRIBUTOR SERVICE FROM OIC

THE OHIO INJECTOR COMPANY

251 Main Street, Wadsworth, Ohio

For more facts circle 229 on Reader Service card, p 99



Space-saving Grinnell Hangers snugly support hot piping in cramped places.

Hot-to-handle piping . . . little space to spare . . . both problems solved with Grinnell Pipe Hangers

Grinnell Hanger assemblies support feedwater piping at 500,000-kw. power station

American Electric Power Company's 500,000-kw Philip Sporn Station, Unit No. 5 at New Haven, West Va., is one of America's largest power stations. The feedwater piping from the heater to the steam generator presented especially difficult heat and space problems for pipe supports — problems solved by Grinnell Pipe Hangers.

The 14-inch feedwater piping — with walls 1-13/16 inches thick — heats up to 560°F . . . takes pressures up to 4860 PSI. What's more, the piping runs unusually close to ceilings and beams!

To keep reactive forces at terminal points within specified limits, space-saving Grinnell Constant Support Hangers are used. Where piping is subject to vertical movement but does not require a constant support type, Grinnell Variable Spring Hangers are used. In fact, more than 1700 Grinnell Hangers were engineered for the Philip Sporn Station!

Grinnell can solve *your* pipe support problems, too. Grinnell designs, manufactures and supplies a complete line of pipe hangers and supports . . . offers design assistance and field engineering service. Write Grinnell Company, Inc., Providence 1, Rhode Island.

GRINNELL

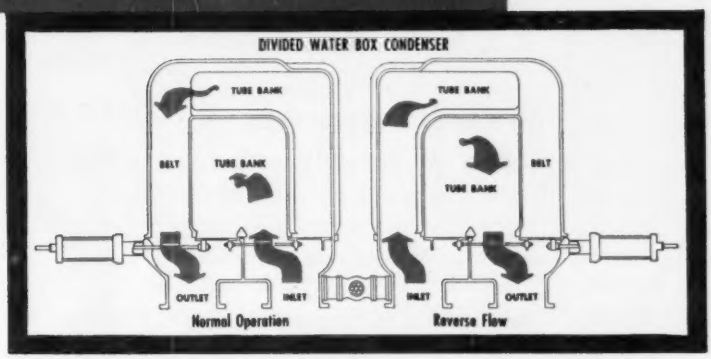
AMERICA'S LEADING SUPPLIER OF PIPE HANGERS AND SUPPORTS

For more facts circle 230 on Reader Service card, p 99

REVERSE FLOW "SELF-CLEANING"

ELIMINATES CONDENSER DOWN TIME

AND CUTS YOUR MAINTENANCE COSTS



C. H. Wheeler "Patented" Reverse Flow Condensers eliminate *manual labor* for cleaning. Refuse, twigs, leaves, debris, algae, or mussels are freed and washed away by back-flushing tubes and tube sheets, without shutting down the condenser.

Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure drop; hence high vacuum is maintained. Sluice gates for each half of the condenser move on a common stem. They are an integral part of the condenser and no extra external piping is required.

Each half of the condenser can be back-flushed independently or both halves can be flushed simultaneously, with either one or two circulating pumps operating.

For complete Reverse Flow "Self-Cleaning" story— write for catalog W-503. To know how Reverse Flow "Self-Cleaning" can cut YOUR condenser down time costs—call your C. H. Wheeler representative.

Affiliated sources for steam condensers, heat exchangers, pumps, nuclear steam generators and related components, sea water distillation plants, marine auxiliary equipment.

C. H. WHEELER Philadelphia 32, Pa. / **GRISCOM-RUSSELL** Massillon, Ohio

DODGE HAS MORE PROVED BEARINGS THAN YOU HAVE BEARING PROBLEMS!

It pays to buy from a line of stock bearings—bearings that have been proved in thousands of installations similar to yours. You benefit by getting known dependability; and you get the important savings of high quality at production price.

PIN-POINT SELECTIVITY

Dodge has supplied mounted bearings to industry for over three-quarters of a century. Dodge bearings have always kept pace with improved production practices. Each new condition of service has been met by Dodge as it has arisen, with the result that the Dodge line contains mounted bearings to meet almost every service requirement with pin-point accuracy.

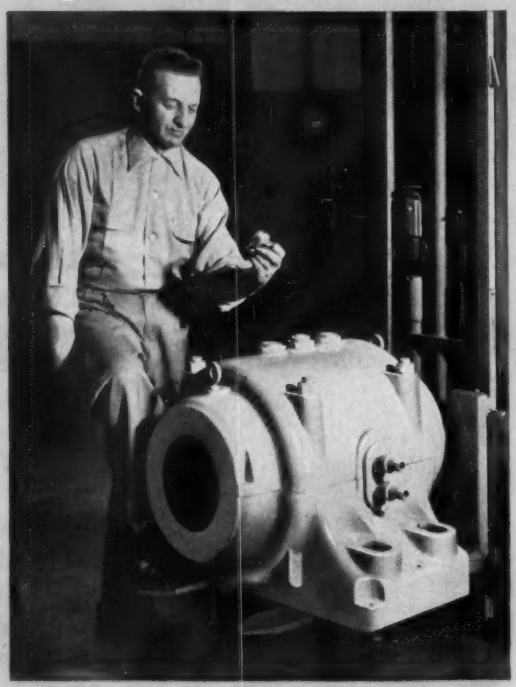
High load, high speed, excessive dust, moisture, corrosion, high or low temperatures, continuous operation—you name it!—such conditions and their combinations are met every day with Dodge bearings.

BROAD LINE—WIDELY DISTRIBUTED

In the great variety of mounted bearings developed by Dodge, you will most likely find the precise unit to fit your requirements ideally—without paying for features you do not need. And if your requirements call for several types of bearings, there is an advantage in having them of common design, such as Dodge offers.

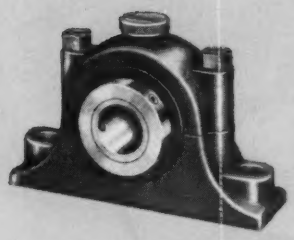
The Dodge line is probably broader than any other line of mounted bearings in America. And of special importance to machinery manufacturers, it is the most widely distributed line. There is always a Dodge bearing of the right type and size near at hand.

You can check this with your local Dodge Distributor. Ask him—or write us for the Dodge Bearing Bulletin.

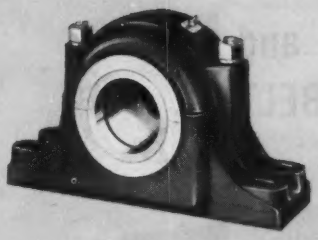


In addition to tapered roller, spherical roller and ball bearings, Dodge builds many types of sleeve bearings. Here is the "large and small" of the sleeve type bearings carried in stock—ranging from an 8-in. Sleevoil weighing over 1200 lbs. to a ½-in. solid journal bearing weighing 9 ounces.

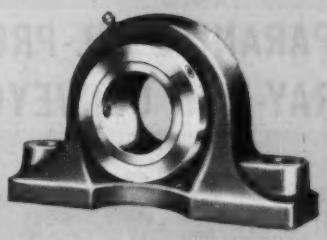
DODGE MANUFACTURING CORPORATION, 3200 Union Street, Mishawaka, Indiana



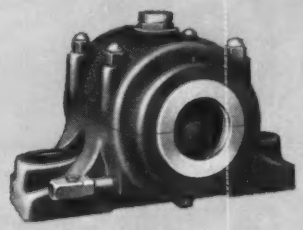
DODGE PILLOW BLOCKS WITH TIMKEN TAPERED ROLLER BEARINGS



DODGE SPHER-ALIGN PILLOW BLOCKS WITH SPHERICAL ROLLER BEARINGS

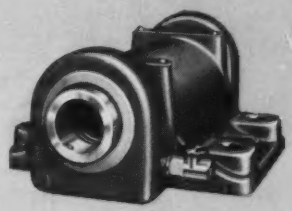


DODGE BALL BEARING PILLOW BLOCKS

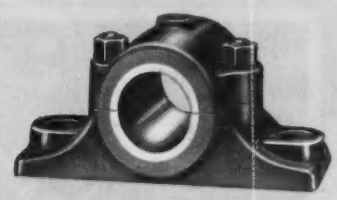


DODGE SLEEVOIL PILLOW BLOCKS

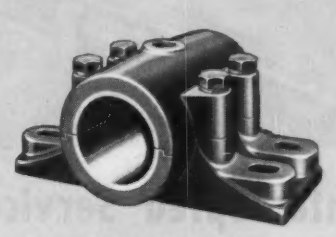
DODGE BRONZOIL PILLOW BLOCKS



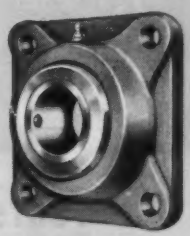
DODGE BRONZE BUSHED PILLOW BLOCKS



DODGE JOURNAL BEARINGS SOLID AND SPLIT



DODGE HEAVY RIGID PILLOW BLOCKS



FLANGE BEARINGS: HANGER BEARINGS: BEARING UNITS: TAKE-UPS

● **Dodge Pillow Blocks with Timken Tapered Roller Bearings.** America's quality pillow blocks. Assembled, lubricated, adjusted and sealed at the factory. 5 types for varying needs.

● **Dodge Spher-Align with Spherical Roller Bearings.** Rugged heavy duty, compact, inherently self-aligning. Exclusive Micro-Mount simplifies installation.

● **Dodge Ball Bearing Pillow Blocks.** Deep groove ball bearings with long inner races—high capacity. SL, SC and SCM models for light, normal and medium service respectively.

● **Dodge Sleevoil Pillow Blocks.** Ultra quality . . . extra long life . . . accessibility . . . *quiet*. Plain or water-cooled.

● **Dodge Bronzoil Pillow Blocks.** Efficient, low cost pillow blocks with self-oiling, capillary bronze bushings. Self-aligning. Large oil reservoirs.

● **Dodge Bronze Bushed Pillow Blocks.** Quiet fan and blower pillow blocks with two bronze bushings of high lead content mounted in one cast iron housing.

● **Dodge Journal Bearings — Solid and Split.** True running, dependable. Babbitted bearings with precision machined bores and faces. Finished bases.

● **Dodge Heavy Rigid Pillow Blocks.** Rugged, carefully bored, babbitted pillow blocks for many applications requiring grease lubrication. Finished bases and ends.

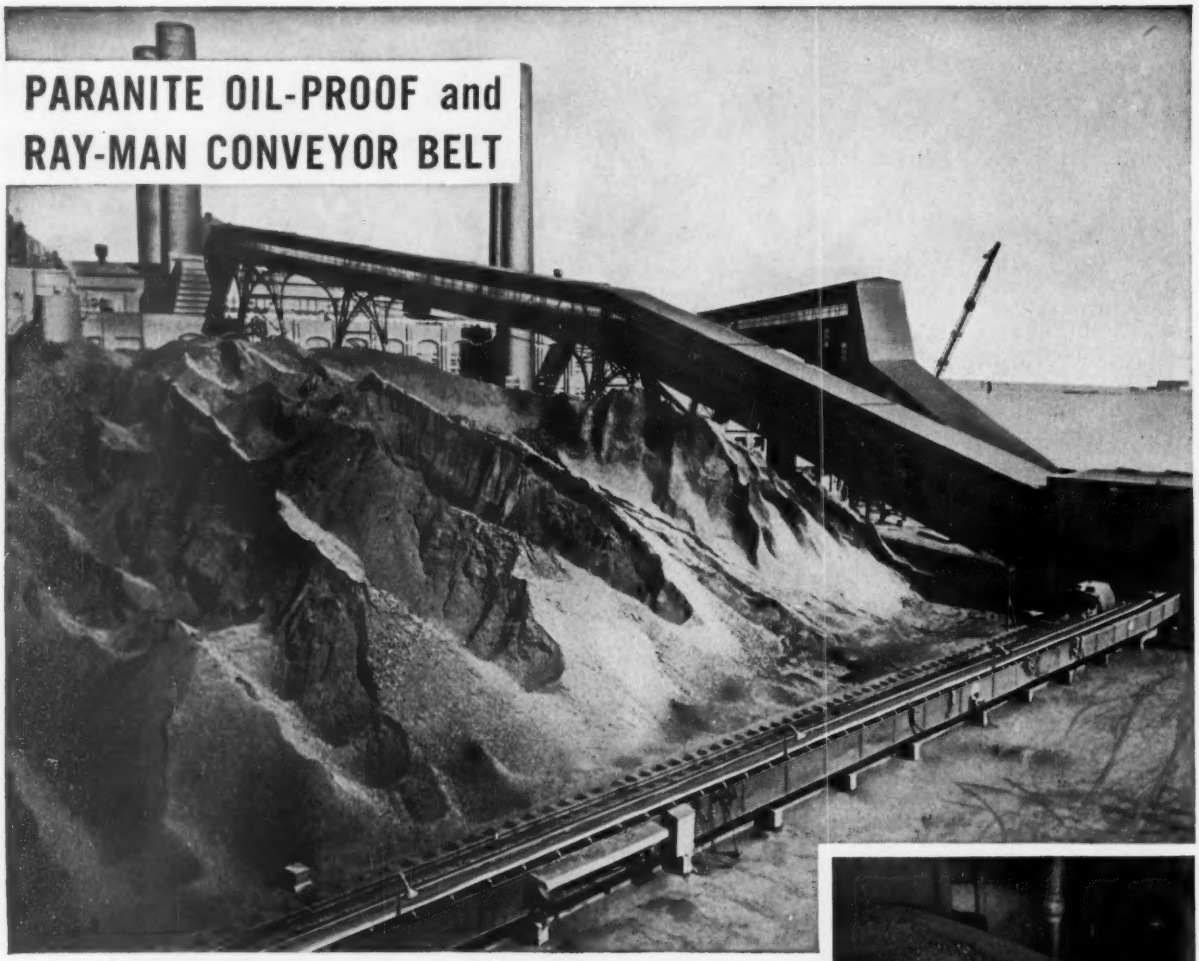
● **Bearing Units.** A wide variety—spherical seat, cartridge, flange, hanger, screw conveyor hanger, take-up. Ball, Roller and Sleeve types.

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the *white* pages of your telephone directory, or in the yellow pages under "Power Transmission Machinery."

DODGE

of Mishawaka, Ind.

For more facts circle 232 on Reader Service card, p 99



Over 20 Years' Uninterrupted Service At A Major New England Power Plant

The year: 1940. The requirement: 4,000 feet of conveyor belt to carry oil-treated coal from stockpile to boiler plant at a large electric light and power plant. This meant a "new" oil-proof conveyor belt able to withstand oil emulsion without swelling and causing excessive spillage. The recommendation: Manhattan's Paranite Oil-Proof Conveyor Belt with neoprene cover, one of the first all-synthetic rubber belts made for handling oil-sprayed coal and coke. Result: The Paranite Belt installation did the job . . . and continues to do the job today after twenty years of trouble-free service!

RAY-MAN BELT

Where oil is not a problem, Ray-Man Conveyor Belt will outperform all others. Precision proportioned for perfect balance. Double compensation relieves outer ply stress at bends. Trains naturally, holds fasteners better, resists impact and ripping, requires no breaker ply. Exclusive "XDC" cover for much longer wear. Troughs deeply for 45° idler operation to increase load capacity up to 60%. See your R/M Distributor or write for Conveyor Belt Catalog 25 CB.

CLOSE-UP VIEW OF PART OF 4,000 FOOT PARANITE CONVEYOR BELT. NOTE CONDITION OF BELT AS IT FLEXES OVER PULLEY. TWENTY-YEAR-OLD INSTALLATION IS THE LARGEST OF ITS KIND.

RM 115

RAYBESTOS-MANHATTAN, INC.
MANHATTAN RUBBER DIVISION • PASSAIC, N. J.
ENGINEERED RUBBER PRODUCTS

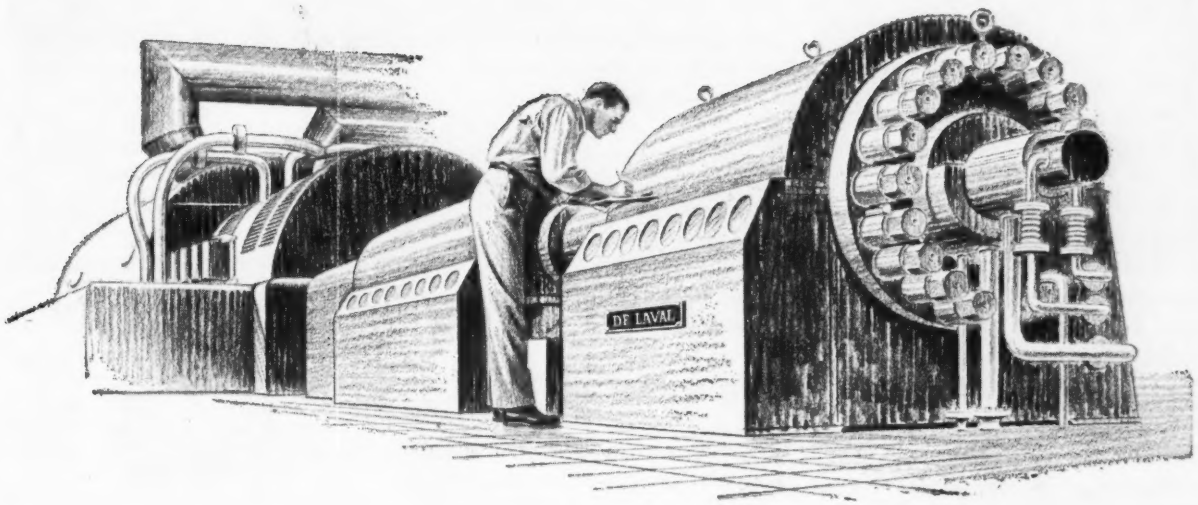
DE LAVAL

engineering ingenuity means low-cost feed for giant boilers

Electricity remains "America's biggest bargain" because of the applied engineering ingenuity of the nation's electric utilities and their suppliers. Case in point: the planned installation of high-capacity De Laval boiler-feed pumps at a prominent utility. For the first time in a U. S. utility, boiler-feed pumps will be driven through the governor end of the main steam turbine-generator. Costly energy-conversion processes will be eliminated; more electricity will be available for sale. The utilities will gain another tool in their continuing effort to hold the line on cost.

Whether you have giant boilers to feed, or other problems involving rotating machinery, De Laval engineering ingenuity can help.

De Laval Steam Turbine Company, Trenton 2, N. J.



MC-DL-103

DE LAVAL · 60 YEARS OF CREATIVITY AND QUALITY

CENTRIFUGAL PUMPS AND COMPRESSORS • TURBINES • IMO® ROTARY PUMPS AND HYDRAULIC MOTORS
MARINE PROPULSION AND AUXILIARY EQUIPMENT • HELICAL AND EPICYCLIC GEARS • TURBOCHARGERS

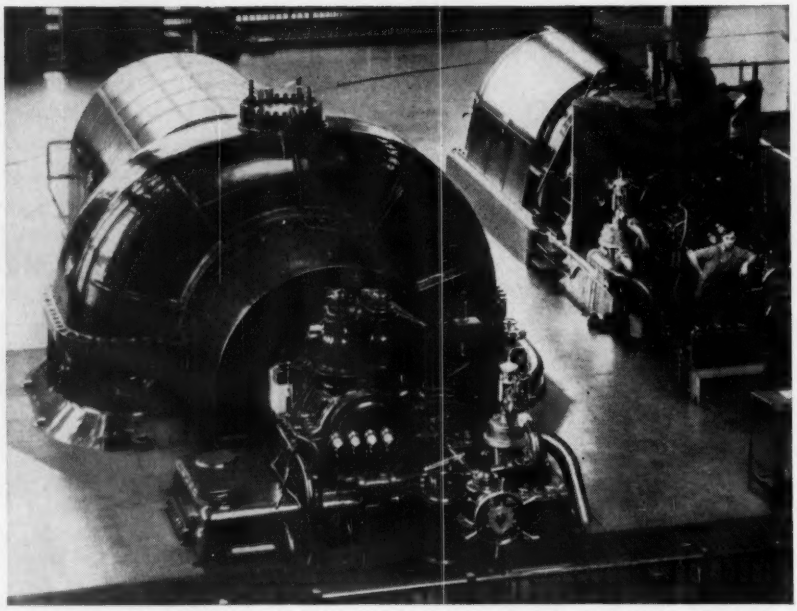
For more facts circle 234 on Reader Service card, p 99

TURBINES:

Shell reveals three ways that Turbo Oils help prevent oil breakdown, rust, sludge and foaming

Small quantities of air and water can work their way into any turbine lubrication system. These contaminants can accelerate oxidation of the oil.

Read how Shell scientists developed a specific formulation that counters this oxidation and brings you turbine lubricating oils with top performance records.



Shell Turbo Oils lubricate turbines with total rating of more than 17 million kw in the U. S. and Canada.

WHEN oxygen attacks turbine oil, it can form peroxides and organic acids. A chain of oxidation reactions begins. If the oil stability is inadequate, sludge can form.

Air entrained in the oil can aggravate oxidation. And it may cause foaming.

The oil may also be affected by water in the system. Laboratory tests have shown that water can greatly accelerate an oxidation process.

With Shell Turbo® Oil, Shell tackles these problems in three key ways:

1. *Shell carefully selects base oils for use as turbine lubricants,* then refines them to get the most effective response to Shell's special additives.

2. *Shell adds a powerful oxidation inhibitor to its precisely refined base oils.* This inhibitor helps prevent the chain of oxidation reactions caused by oxygen exposure at operating temperatures. It helps keep the oil in good condition, and lengthens its service life.

The result is that Shell Turbo Oils have proved themselves unusually stable over long service periods.

3. *Shell uses an outstanding rust inhibitor.* As a protective measure, Shell uses special additives that cover metallic surfaces with strongly adherent polar-type films.

These films are specially designed to help keep water from the metal surface.

In drastically accelerated laboratory tests, metals immersed in Shell Turbo Oils show outstanding anti-rust performance—even in the presence of sea water.

Ask your Shell Industrial Products Representative for facts on Shell Turbo Oils. Or write: Shell Oil Company, 50 West 50th Street, New York 20, New York.

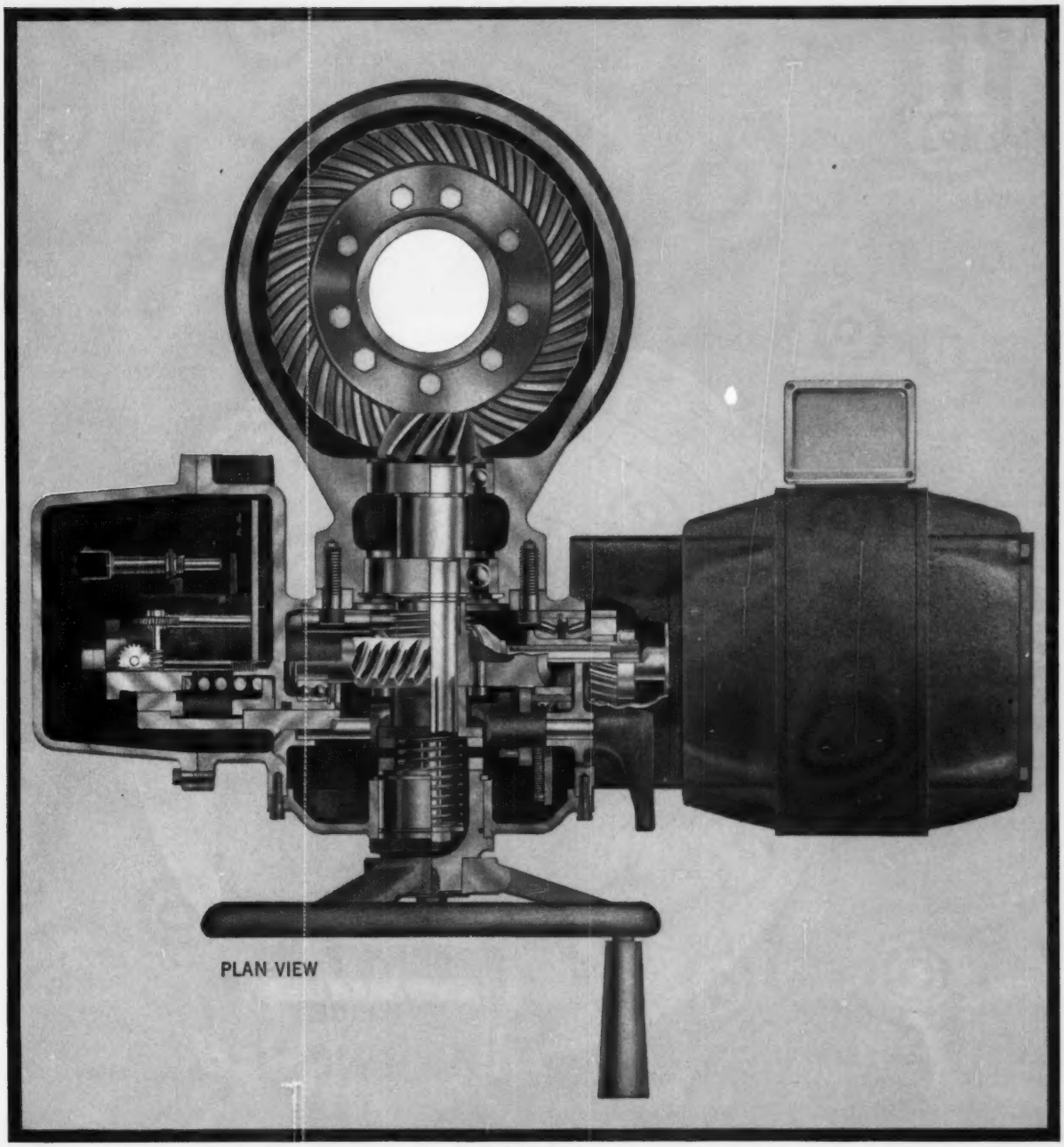
Memo to utilities

Ten turbines in the U.S. have been running on Shell Turbo Oil 27 *since 1938.*

In Canada, Shell Turbo Oils lubricate turbines generating more than half of all steam power produced.

SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are working to provide better products for industry



Now–"Crane Teledyne" motor operator for valves

It's new and only from Crane!

Today Crane is the only full line valve manufacturer that offers its own motor operator; this simplifies and speeds up your ordering and installation. And you get undivided responsibility for performance from one manufacturer.

"Crane Teledyne" was designed to provide torque only (thrust is taken on valve parts). This feature results in lower cost, smaller size and less weight than other operators with comparable output ratings.

We specifically designed "Crane Teledyne" for a wide variety of Crane valves. You can order it in two ways: as a conversion kit to motorize present valves in minutes; or fully motorized Crane valves straight from stock.

The motor operator is equipped to act as a gear-operated valve (4:1 ratio) in case of electrical emergencies. Available with push-button control or can be programmed for automated operation.

For full information, call your Crane distributor. Or write Crane Co., Industrial Products Group, Dept. H, 4100 So. Kedzie Ave., Chicago 32, Ill. In Canada: Crane Ltd., 1170 Beaver Hall Square, Montreal, Que.

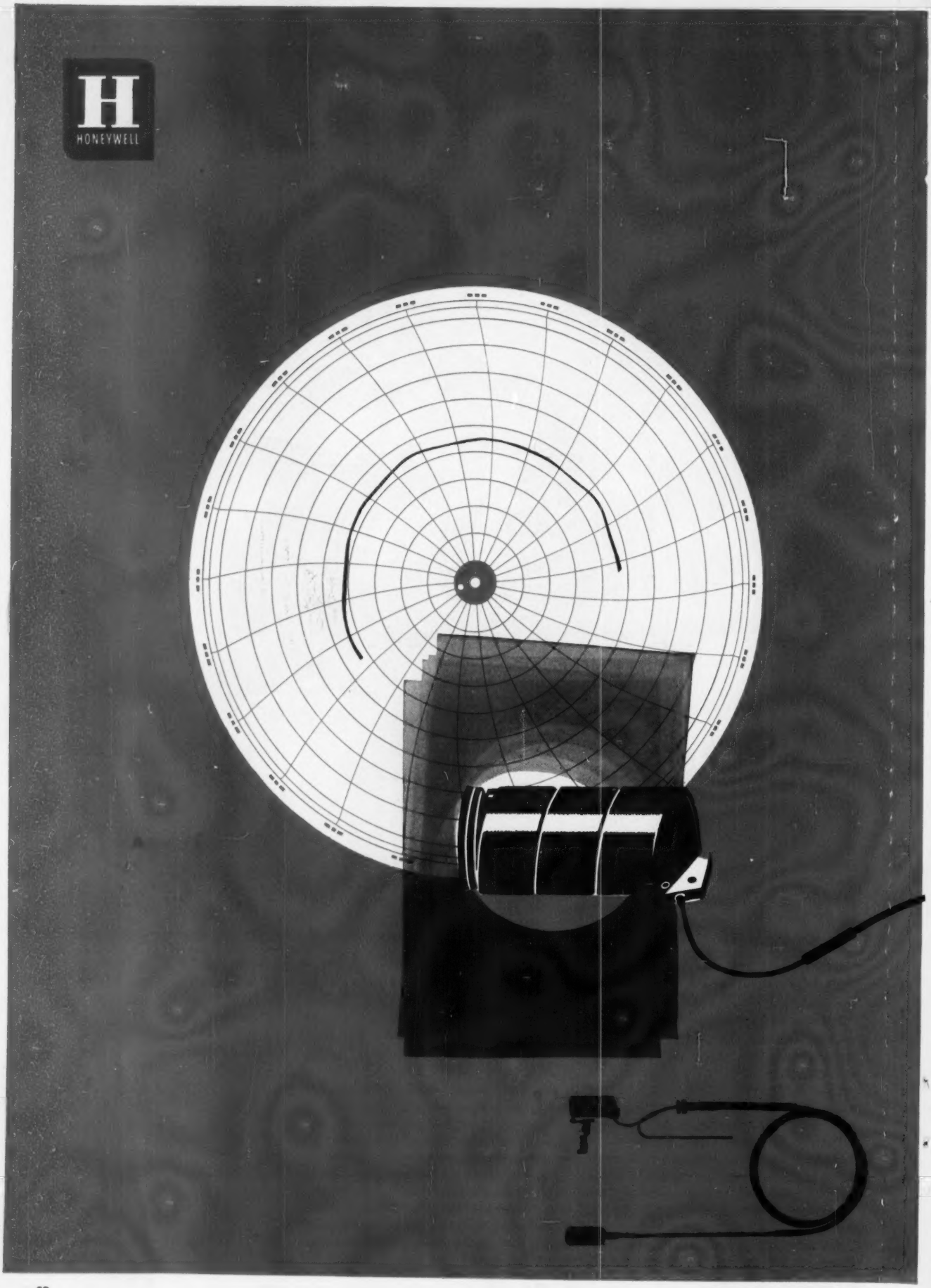
AT THE
HEART
OF HOME AND
INDUSTRY

CRANE

VALVES • PIPING • PUMPS
PLUMBING • HEATING • AIR CONDITIONING
WATER TREATMENT
ELECTRONIC CONTROLS • FITTINGS

For more facts circle 236 on Reader Service card, p 99

H
HONEYWELL



The New Honeywell Thermal System

withstands extreme vibration and corrosion conditions

Here's a new gas-actuated thermal system that takes the zig-and-zag out of temperature recording under severe vibration conditions.

A complete series of vibration tests has proved the vibration resistance of the new Class III thermal system. In these tests, the Class III system was installed in a standard Honeywell rectangular case recorder, and subjected to forced vibrations in three mutually perpendicular planes. With accelerations up to 0.2G from 0 to 200 cps, maximum pen oscillation was limited to 1.5%. For more than 75% of the range, *pen oscillation was less than 0.5%!* . . . with no resonant effects at 60 cycles.

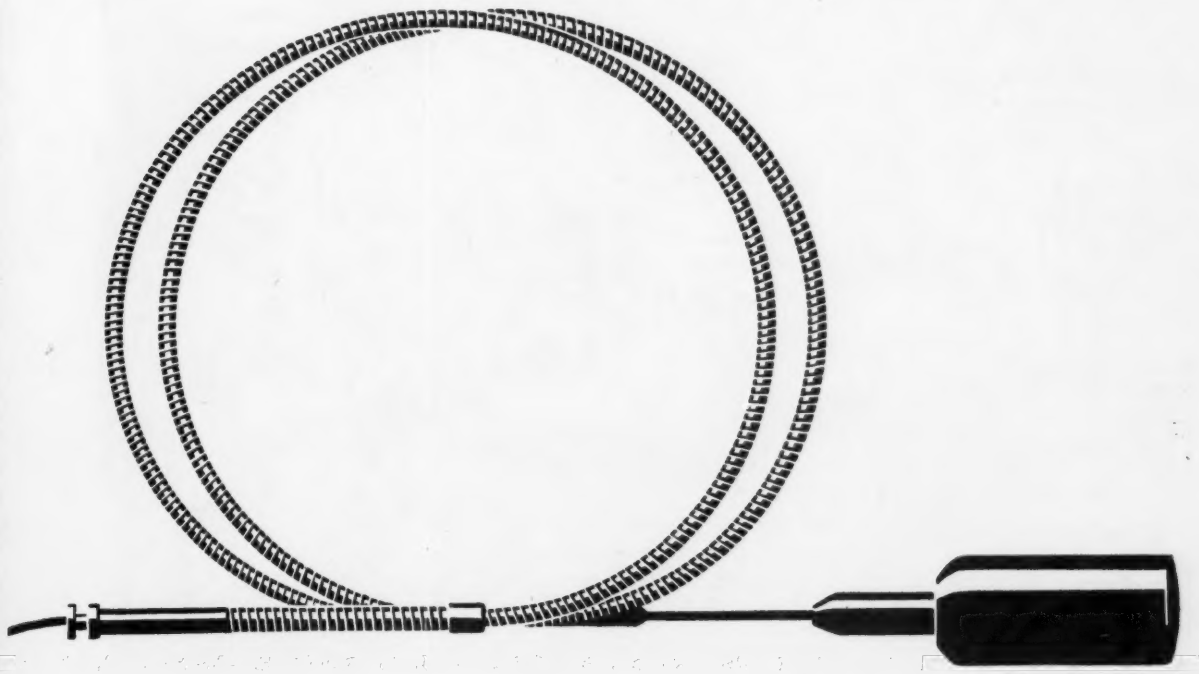
Check these many new design and construction features: high-energy helix for increased sensitivity and lower dead spot; built-in overrange or underrange protection; stainless steel bulbs to withstand corrosive atmospheres; low carbon 316 stainless steel linkages with low-friction, ball-joint construction; coarse and fine zero adjustments for easy settings.

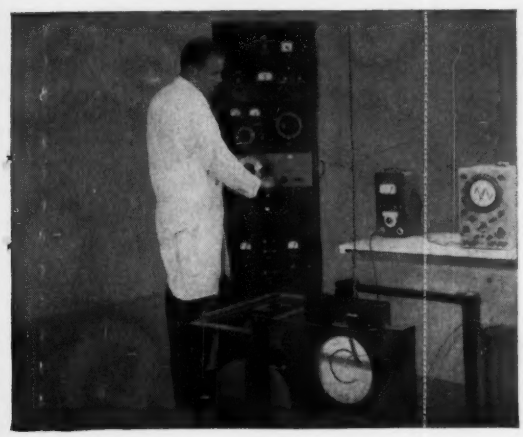
Get the complete story on the new Class III Thermal System by contacting your nearby Honeywell field engineer today. He's as near as your phone. MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pennsylvania.

Honeywell

First in Control

SINCE 1885





POWELL PERFORMANCE PAYS OFF

Any way you look at it, Powell Valve performance really pays off—performance that's conclusively proven in power plants everywhere.

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300-pound Steel Globe Valve with welding ends. Outside screw rising stem and yoke. Bolted flanged bonnet. Screwed-in seat ring. Sizes, 1" through 12". Screwed or flanged end valves are available.

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See our catalog in Sweet's

115th year of manufacturing industrial valves for the free world

POWELL STEEL VALVES

THE WM. POWELL COMPANY CINCINNATI 22, OHIO

For more facts circle 238 on Reader Service card, p 99

LOUIS N ROWLEY, EDITOR • NOVEMBER 1961 • ESTABLISHED 1882 **Power**

Planning for the unexpected

Not long ago, an ad in the *Wall Street Journal* turned my thoughts toward an important change that has taken place in recent years. This particular ad appeared in their Southwest edition immediately after Hurricane Carla had struck. Its message was simple: all resources of Worthington Corporation were being made available on a priority basis to restore damaged equipment to service.

This action was not unique, of course—that is just the point. In recent years, manufacturers of equipment for the energy systems that are the life-giving arteries of our modern industrial civilization have increasingly recognized their responsibilities in situations of this kind. In growing numbers they have organized their service operations so they can rapidly concentrate on areas affected by disasters. Quick availability of skilled manpower, spare parts and replacement equipment has contributed enormously to the early restoration of public services and industrial operations, made disasters less disastrous.

Although public utilities have long been skilled in coping with disaster conditions, they have brought their operations to an increasingly high pitch. With improved communication methods, a greater degree of standardization of equipment and procedures from company to company and a truly effective cooperative approach, they can now bring to bear on a devastated area a concentration of resources that goes far beyond what is normally available.

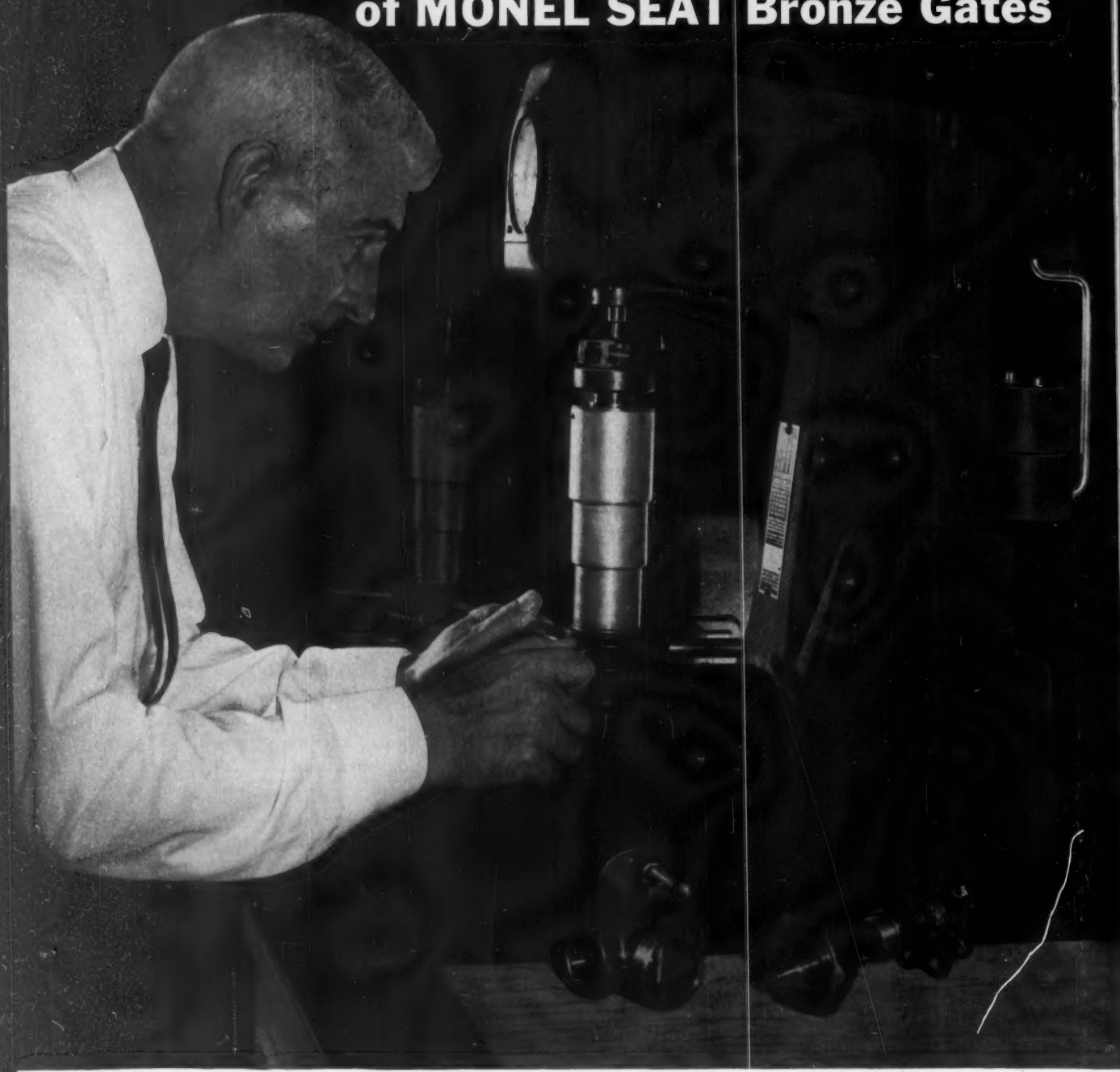
Another major contribution to disaster control comes from the increasing attention being paid to it by industrial plants and institutions such as hospitals. Farsighted engineering managements have studied their facilities and analyzed their operations with a view to minimizing immediate effects of fire, flood, wind and other catastrophic hazards. And, perhaps most important, they have worked out programs for the fastest possible recovery from whatever damage may be inflicted.

But there are still many plant managements to whom disaster is something that happens to the other fellow. When disaster strikes them, it wreaks maximum havoc because nothing has been done to prevent or reduce damage. And without a plan and the technical know-how to carry it out, the aftermath is chaos rather than an organized drive to restore operations quickly.

There is no excuse for failure to prepare for trouble, because preparedness is mainly planning. You can do a lot without investing more than pennies. And there is a wealth of information available on organizing for disaster control, on procedures for restoring damaged equipment. If you don't have at least a rudimentary plan for protecting vital energy systems in your plant and getting back into operation fast, better start right now—you'll find it time well spent.

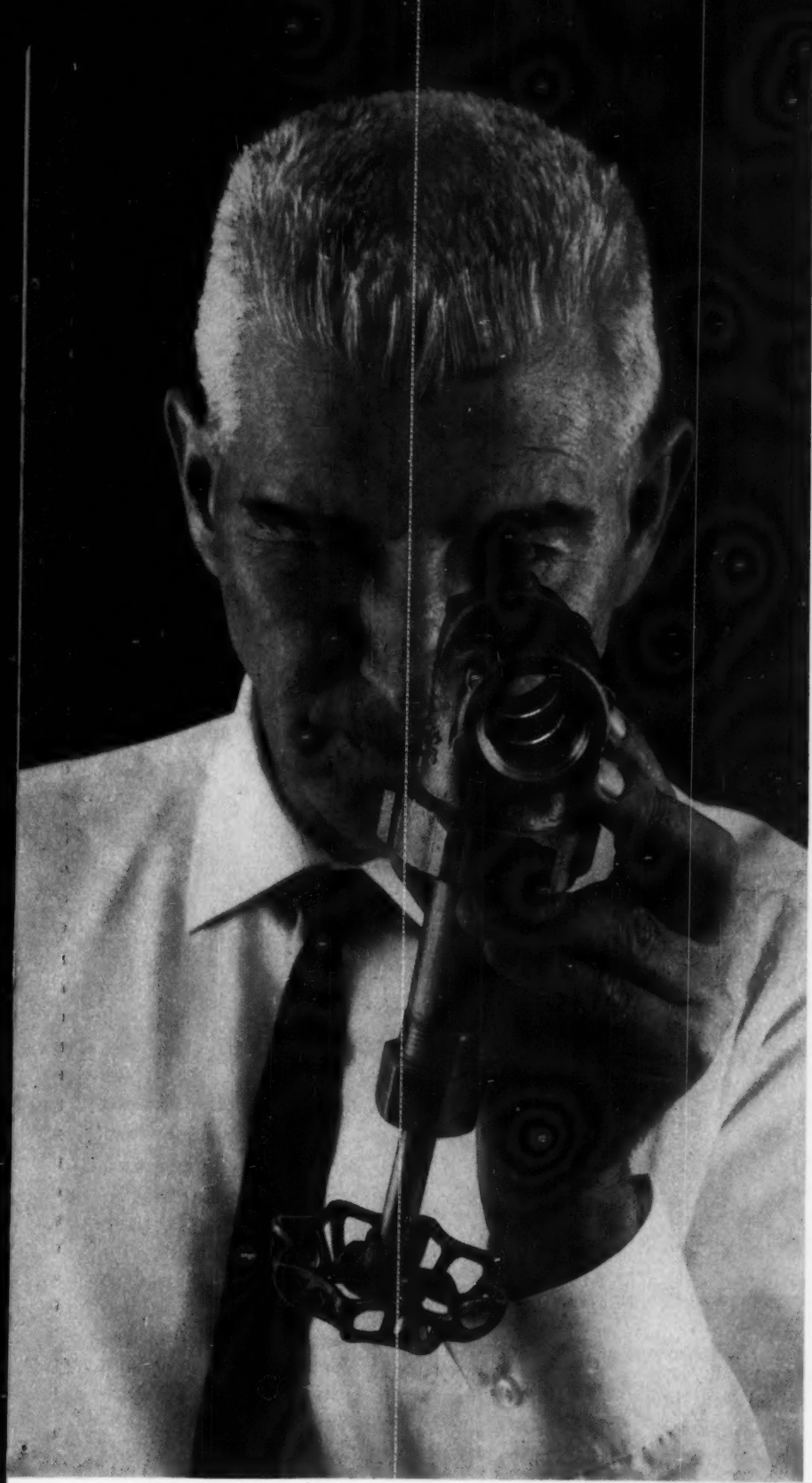
Look into 2 things...

to slash maintenance costs of MONEL SEAT Bronze Gates



What is the RELATIVE HARDNESS of the Wedge and the Seat Rings?

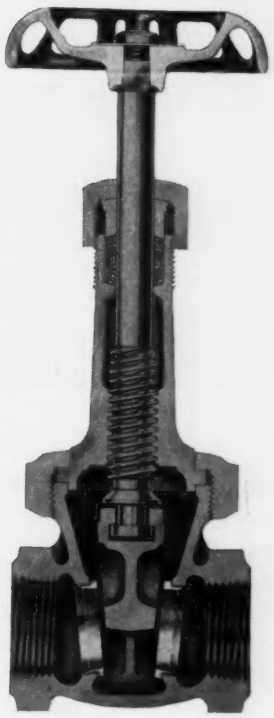
If the bronze or nickel alloy wedge is less hard than the monel seat rings, the wedge will wear. That is GOOD . . . with the wedge taking the wear, the seat rings will NOT wear, at least, not enough to worry about. So, you avoid the costly, time-consuming task of replacing seat rings or valve body. It's a cinch to replace a worn wedge . . . merely slip off the old and slip on the new.



JENKINS
HAS THE ANSWERS

— to simpler, lower cost maintenance. Jenkins gives you a wedge that takes the wear to save the seat rings. Jenkins expands seat rings into the body. These are only 2 of the money-saving features of Jenkins MONEL SEAT Bronze Gates and the many other types of bronze gate valves which your local Jenkins Distributor stocks to supply your needs.

WRITE FOR FOLDER 181-C which gives complete information about all Jenkins Bronze Gates. Jenkins Bros., 100 Park Avenue, New York 17.



How are SEAT RINGS SECURED in the body?

A seat ring leak in a Bronze Gate Valve means big trouble and expense! To avoid it, be sure there is no possibility of seat rings loosening, shifting or deforming. Permanent, all-around support is the only sure protection, and to get it calls for EXPANDING (rolling) the seat rings into the body. This becomes practical when the wedge takes the wear and seat rings last for years and years. There's no need to replace seat rings.

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MOST TRUSTED TRADEMARK IN THE VALVE WORLD
VALVES

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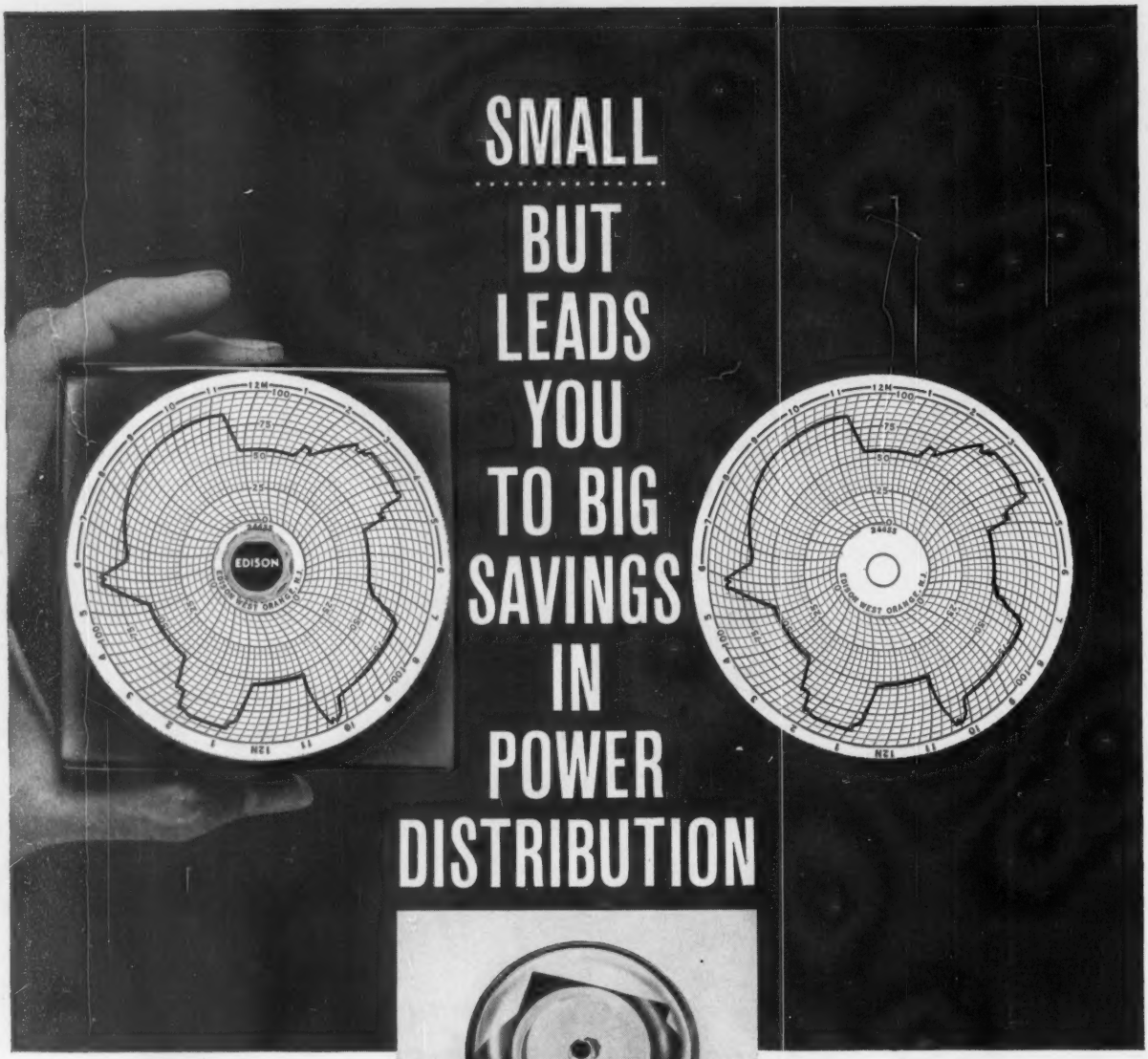
SMALL ..... BUT LEADS YOU TO BIG SAVINGS IN POWER DISTRIBUTION



WEATHER PROOF HOUSING

This compact instrument is the Edison Omnicorder—an accurate yet inexpensive tool that gives you a continuous *record* of fluctuations in electrical load. By using it at strategic points within your distribution system, you can gather data of great economic value in your day-by-day, hour-by-hour matching of station and line facilities to customer load demands. In like manner, you can achieve optimum performance with cost savings in your design of new circuits and selection of components. Available in weather-proof enclosure, the unit is temperature compensated for reliability in any weather; may be panel or bulkhead mounted; has no ribbon, pen or ink that require servicing. Omnicorders can also be used to advantage in sub-stations on *voltage regulators, reclosers, transformers* and *power switching apparatus.* Edison Omnicorder offers a choice of four types of meter movements to measure a wide range of AC and DC electrical quantities, all the way from thermocouple outputs to currents as high as 100 amperes.

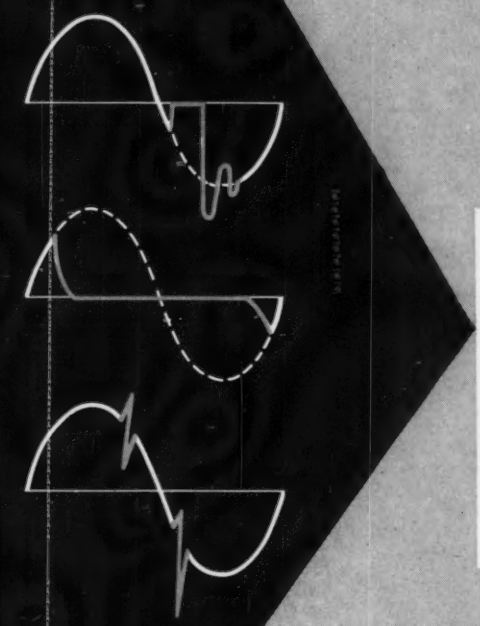
For complete information, please write requesting Catalog 3057.

Thomas A. Edison Industries
INSTRUMENT DIVISION
43 LAKESIDE AVENUE, WEST ORANGE, N. J.

Design and equipment application section

B G A SKROTZKI
Associate Editor in Charge

a Today's Development report



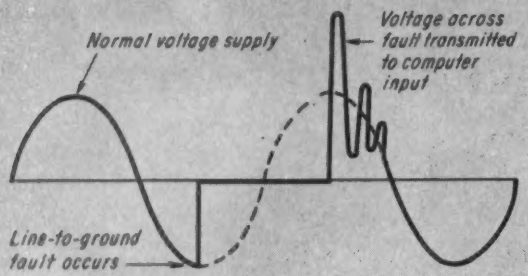
DATA-PROCESSING SYSTEMS:

How pure an electric supply?

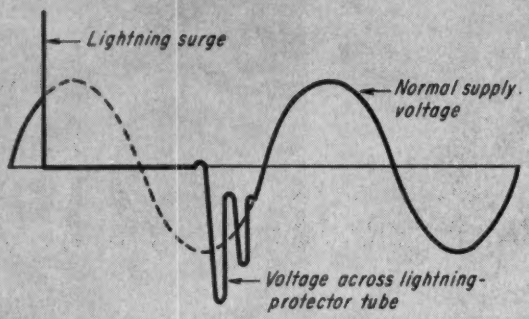
- Some computer error and equipment damage are being traced to transients developed on utility system and in plant
- Rotating equipment proves one practical way to buffer the power supply; added WK^2 tends to smooth voltage dips
- Designers of solid-state ac-dc converters talk about electronic flywheel with a capacitor-transistor team
- Storage batteries make a strong bid for standby duty, powering both m-g sets and static inverters
- Engine-generators in use now have flywheel and circuitry designed for power transfer without interruption
- One thing is sure: There's a job ahead for computer makers, utility planners and energy-systems engineers

By J J O'CONNOR
Managing Editor

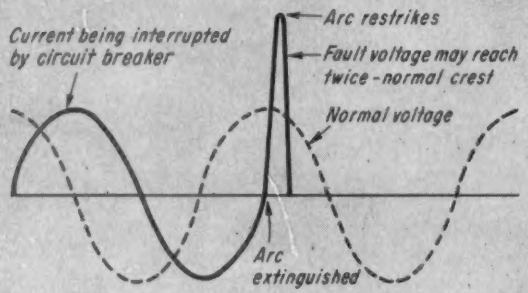
During the height of a summer thunderstorm lightning fingers its way to a high-voltage substation. But the utility protective scheme goes to work and the system remains essentially undisturbed—with one notable exception: a multi-million-dollar computer installation miles away cycles down after some of its sensitive innards fizzle because of the lightning transient. It is 36 hours be-



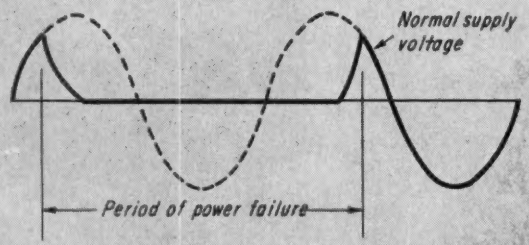
SYSTEM FAULTS when removed tend to create transient peaks in voltage pattern because of line-feeder capacitance. If allowed to reach computer, recovery voltage can do harm



LIGHTNING STRIKE creates an oscillating trace in protector tube spanning line and ground. Where lightning is problem install additional protection on load side of primary sub



SWITCHING SURGES and arcing grounds can build momentary voltage to twice normal. Above trace was taken at terminals of generator grounded through neutral reactor



POWER FAILURE exceeding one cycle can cause trouble in some computers; others will tolerate more. Maximum period may be lengthened by increasing energy storage in system

Transient spikes, dips, interruptions often go undetected

fore the computer goes back on line.

During the early morning hours some months later an electric transient drops out a tape station within the modern abacus, causing a 4-hour stoppage. Hypothetical? Far from it. These two outages were taken from the operating log of a modern computer installation whose owners boasted they never had a prolonged power outage in the last 25 years.

Although these electric transients would prove harmless to most electric equipment, the modern computer is particularly sensitive to changes in voltage and frequency.

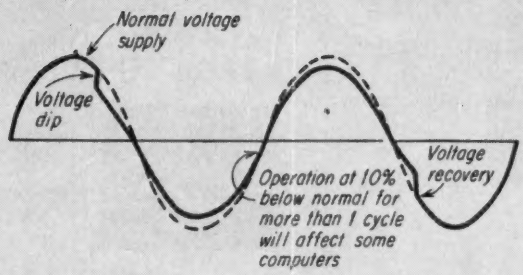
Transients are born in a variety of ways, some on the utility transmission system, others on in-plant distribution feeding the electronic data-processing (EDP) equipment. One major builder of computing gear claims that by far the majority of harmful transients studied in connection with his EDP systems begin on the customer side of utility supply.

Voltage dips, the kind that affect computers, often arise from faults somewhere on the electric system. Faults can drop, and at times raise, voltage momentarily beyond nominal values. Consider a utility subtransmission bus with several sections separated by normally closed section breakers. A fault on any line served from the bus drops voltage for the time the relay takes to pick up and accompanying breakers to operate.

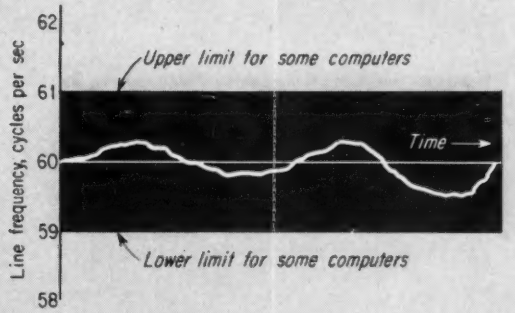
Size of the dip varies with fault impedance while relay operating time is normally a function of fault current. Faults producing a big voltage dip, say 75% of nominal, might pick up the protective relay in one cycle. For lesser faults occurring some distance from the bus, voltage may dip only 20% of nominal, but relay time may climb to 25 cycles. Combined relay pickup time plus breaker operating time for heavy faults might range between 3 and 9 cycles on some systems. For lesser faults, yet big enough to interfere with computer operation, the combined time could well be 30 cycles.

Overvoltages come from a number of sources, some of which are covered in sketches above. Systems without grounded neutrals are characteristically subject to overvoltages. They come about when "sputtering" faults team with a circuit of system capacitance (mainly cables) and system inductive reactance. Voltage builds up between phases and ground to several times nominal line-to-line.

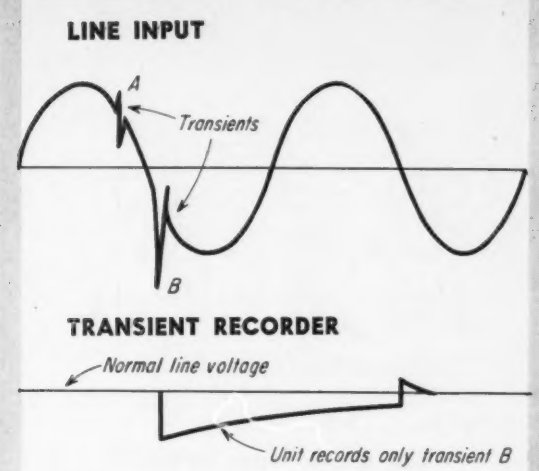
But overvoltages may occur sans sputtering faults: lightning, contact with higher system voltage, resonance in series inductive-capacitive circuits, to name a few, can produce them. Proper equipment grounding—and


Normal voltage supply
Voltage dip
Operation at 10% below normal for more than 1 cycle will affect some computers
Voltage recovery

VOLTAGE DIP, such as met when lines are temporarily overloaded, must be held within computer's specified limits. A large motor started in plant may also be a trouble cause



LINE FREQUENCY if other than normal 60 cps will affect speed of EDP peripheral motors and computer-power-supply dc outputs. This is more a problem abroad than in the U.S.



How to detect transients

It is impractical to detect random power transients on conventional display equipment, such as an oscilloscope. A long-persistence screen may sometimes be used but it fails to provide a permanent record of the surge.

One scheme for spotting overvoltage uses an isolation transformer and bridge rectifier whose output drives a strip recorder writing the rms value of line voltage. Transient pulses greater than a preset level pass through a diode gate and trigger a vibrator. Output of vibrator is a current pulse which drives a recorder pen (*Electronics*, July 21, 1961, p 74).

Another method utilizes a thyratron whose grid becomes more positive on line dips. Tube fires to operate a mechanical counter.

yet account for some computer error and much lost time

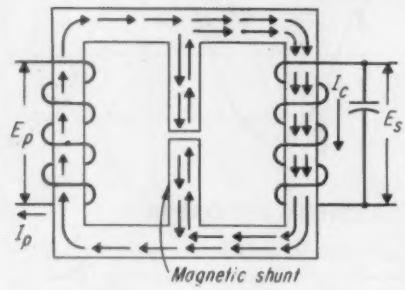
this is apart from neutral grounding —will go a long way toward eliminating voltage spikes from RF sources within the EDP equipment itself. A separate equipment ground from each unit in the computer system, rather than a looping scheme, is often recommended practice.

How sensitive are digital computers to variations in their electric inputs? To better approach an answer let's look first at the electric input to a modern data-processing layout. The feed is often 3-phase 4-wire 208/120-v with many individual loads fed single phase. Some of the input is utilized directly in the form of ac. But another sizable chunk goes through what computer people call a *power supply*. This device transforms the ac input to more modest voltage, than rectifies it.

Power-supply unit for one of the latest computers is a solid-state voltage-regulating combine that offers many dc output voltages to the transistorized digital computer. Dc outputs total seven, ranging from −3 to +48 volts. Nominal ac input is 115 rms, yet a 10% voltage variation either way is compensated for. As specifications spell it out, 20% transients must be safely carried up to 6 cycles without damaging the power supply; allowable dc voltage variations are also well defined. So within the framework of this specification most transients would prove harmless. But this spec was set up by one computer manufacturer last June. What about the other manufacturers and what about computers now in the field? To get the answers, POWER surveyed some leading makers of data-processing equipment. Here's what we found:

One computer manufacturer says his equipment's steady-state and transient voltage limit is ±15%. Any swing beyond this tolerance for ½ cycle or more may result in dc voltages falling outside limits with resulting loss of program sequence. And if the ac input hangs at the lower tolerance for 3 or 4 cycles the computer will shut down. Atop these tight requirements, frequency input must be held to 60, ±1 cycle. Even though there is indication these limits may broaden in tomorrow's designs, permitting a range from 47 to 63 cycles, this will not solve the frequency problem completely in light of demands of the many peripheral motors in an EDP system.

Another computer builder states that trouble can be expected if input voltage dips below 10% of normal for more than one cycle. Still another permits a 15% voltage change for one cycle. In short, it is generally agreed that short-term dips and

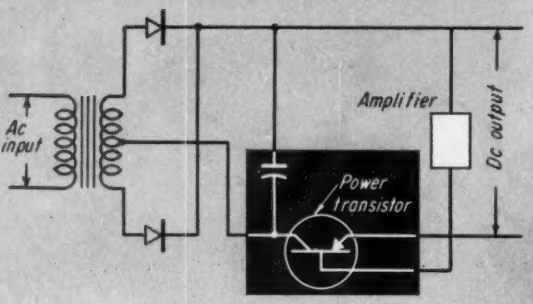


Use a c-v transformer?

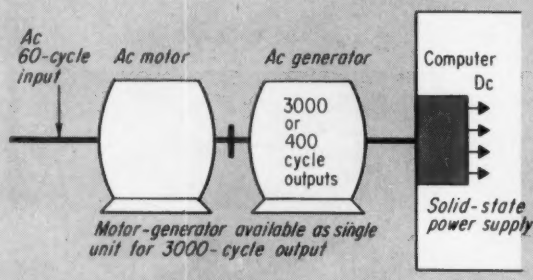
Constant-voltage transformers can be used in dc power supplies to gain a high degree of voltage regulation. They are designed to deliver no more than 150% of rated current, thus protecting rectifiers against initial charging surges and the load from short circuit. Basic elements of a c-v unit are shown above —sans the necessary compensating winding.

In operation, I_c flows in capacitor and secondary winding. Part of flux produced by I_c flows in the shunt without linking primary. Result: variations in E_p on the ac input produce negligible change in secondary flux.

Since the secondary flux is now relatively independent of primary voltage, the secondary voltage produced is essentially constant.



ELECTRONIC FLYWHEEL is built in some solid-state power supplies by teaming capacitor and power transistor. But a voltage spike may charge condenser to a troublesome high



ROTATING FLYWHEEL inherent in m-g sets buffers ac line while providing practical means for generating a higher-frequency supply—a better bet, say some computer makers

Voltage may be helped by static devices, use of rotating

spikes in the supply voltage will cause computer failures unless steps are taken to keep such transients out of the computer's innards.

Transistorized computers, which are fast replacing the older tubed models, place a more stringent requirement on electric supplies. Although there are about 4000 vacuum-tube systems still operating, the number of solid-state computers trebled in the last six months of 1960, going from about 200 in midsummer '60 to well over 700. Today the total would approach 1500. Outside of portable radios and other entertainment-field items, the largest single use for transistors is in computers; most transistors are either silicon or germanium.

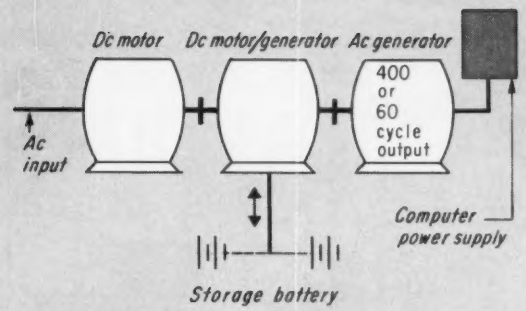
Voltage limits on the semiconductors are rigid: A single transient spike can destroy a silicon rectifier or transistor while low voltage affects magnetic-core memory, may mean loss of data before it can be stored in, among other things.

Designers of computers and computer power supplies have within their province the control of all circuit elements that could generate transients, *except* the power source. So transients within the EDP equipment can be compensated for.

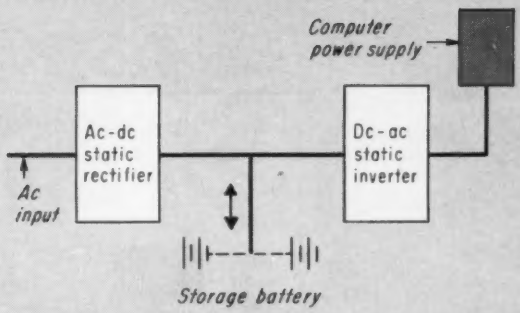
But when a foreign transient makes its appearance and manages to sneak through the computer power supply, effect on output may take the form of error, physical damage or shutdown. In the typical case the EDP operator calls in a serviceman who slips a diagnostic program in the computer, then sets the machine through its paces. Everything checks out and in all probability the real cause of failure remains unknown.

Detecting transients is not an easy job. The rub comes in that the conventional piece of display equipment, an oscilloscope, is useless for detecting random transients. As illustrated on the previous page, special equipment is needed to do the trick. Typical: an analog circuit tied across the line to trigger a counter each time a transient hits. Permanent trace of the transient geometry can be made using a special recorder. In one field installation of such a device, analysis of results after 200 monitoring hours placed the cause of transients right in the owner's plant: switching of compressor motors.

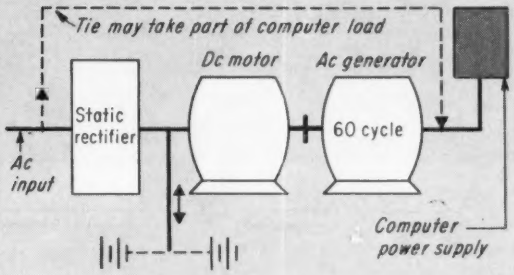
Careful planning goes a long way toward avoiding later troubles. An early conference with a utility representative and a physical-planning engineer from the EDP supplier can pay off. One such meeting led Public Service of Colorado to provide 4-kv automatic feeder-transfer service at two network vault locations in Denver, guaranteeing a feed-



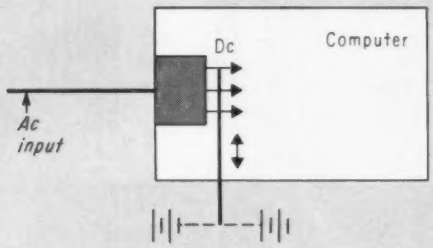
DC MOTOR/GENERATOR interposed between ac motor and ac generator charges the storage battery during normal operation yet serves as driver off battery when ac input dips, fails



ALL-STATIC UNITS with storage battery between offer supply continuity on power failure and computer isolation from spikes, voltage dips and ac-input line-frequency variations



STATIC RECTIFIER powers dc motor in this arrangement, also keeps battery fully charged. Generator output voltage, frequency hold constant, washing out main line transients



STORAGE BATTERY floats across computer's unregulated dc supply. During normal operation a trickle charge maintains battery. Shift over to battery is automatic on ac failure

equipment between computer and feed, while batteries and . .

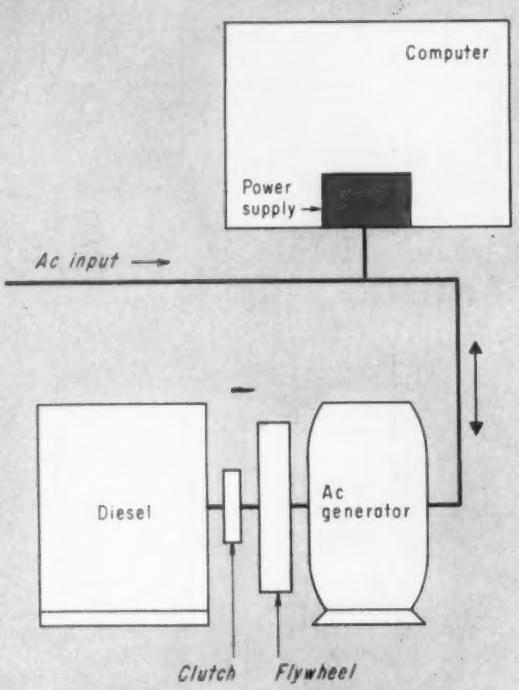
er-transfer time within 9 cycles. This setup serves two computers that process airline flight reservations. Such an arrangement doesn't solve the problem but does meet those particular computers' requirements for supply continuity. Machines involved shut down on a power interruption of 9 cycles or more and can't be restarted for 30 minutes. Since they process 60,000 reservations daily, a shutdown would result in a monumental passenger-ticket tangle.

When laying out feeds for EDP equipment, go back far enough in the plant or building electric-distribution system to tap a source close to the utility lines. A separate transformer and associated switchgear, right in the primary sub, would be the ideal. Take pains to isolate from welding loads, ignitron rectifiers, arc furnaces and similar sources of voltage irregularities. Also, since computer installations tend to grow with the passage of time, design in a *Power-to-grow* factor.

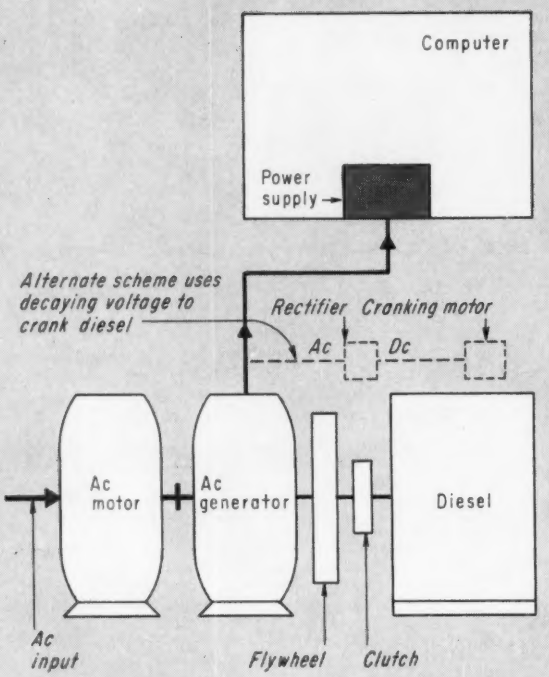
Rotating equipment placed in the line between computer and normal ac supply solves many problems. This rebirth of interest in m-g sets comes about because of inherent and added flywheel effect—a transient leveler, if you will—plus the growing desire to feed computer power supplies with a frequency higher than 60 cycles. One advantage: the higher frequency reduces cost and size of components. Some designers claim hi-cycling cuts ripple on dc outputs.

Static equipment in the ac line is also boasting an ability to ride out transient dips. Under the banner of an "electronic flywheel," at least one power-supply manufacturer claims to tolerate a 6-cycle voltage interruption or distortion. The circuit utilizes a capacitor and transistorized control arrangement, but it's not without drawbacks. This and similar circuitry can introduce a new problem since a voltage spike, above the nominal instantaneous value, recharges the capacitor to a new and higher level. This higher potential poses the threat of transistor burnout in the flywheel circuit, a problem that probably will be solved in time to come. There is nothing magical about a 6-cycle limit; in fact it's not a technical limit, merely an economic optimum. By increasing capacitor size, energy storage could be made adequate to ride out 10 or more cycles.

A new offering in the field of power supplies comes in the form of a series of power modules designed to replace the central high-current units now used. Adopting a small conventional transformer, full-wave rectifier and choke filter as the key ingredients, the power module is



UNINTERRUPTED-POWER SET floats on line when ac feed is normal, clutch open. If power falters, flywheel carries over while clutch ties diesel to alternator, feeds computer



UNINTERRUPTED-POWER PLUS scheme for correcting voltage, phase or frequency of commercial supply. All energy goes through m-g when computer operates from normal feed

. . diesel generators offer varying degrees of standby service

built minus transistors, tubes or capacitors. Each unit is completely sealed in an epoxy encapsulation with aluminum outer housing.

Standby arrangements are many and varied: alternate feed from the utility, storage battery, internal-combustion engine-generator. Early in the game, think through the business of probable outage period and what loss of computer time will cost. On a rented computer, time charges generally cease if unit isn't workable.

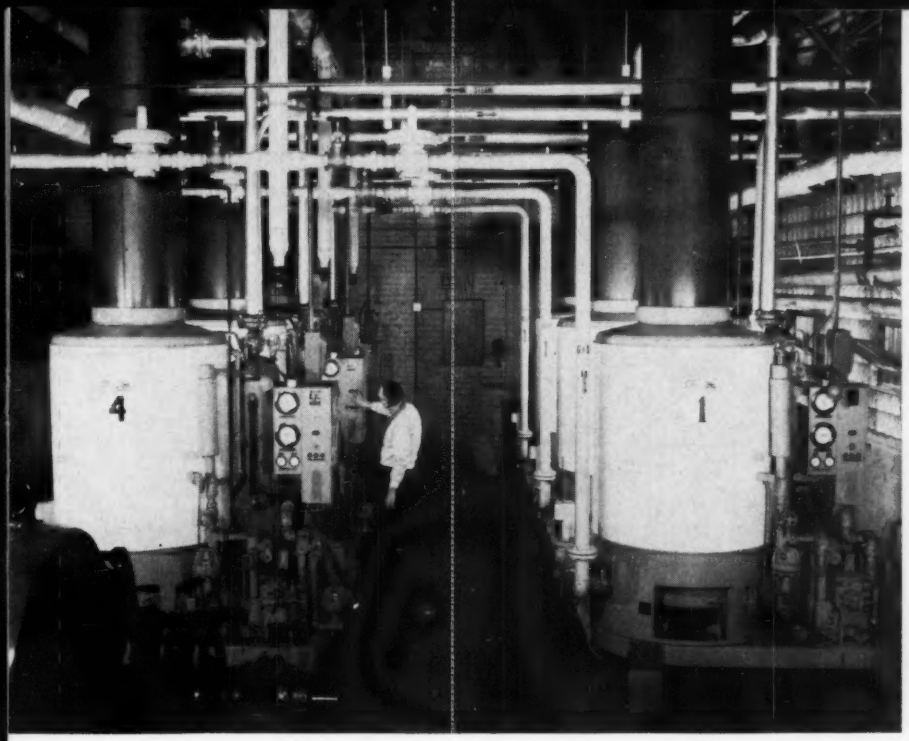
When considering the standby source, remember batteries will carry on for a limited time only, while an engine-generator faces no practical time factor. And since the modern computer requires a controlled climate—60 to 80 F, between 40 and 60% relative humidity is typical—a standby source sized just for the computer load will prove of limited usefulness on prolonged outages.

Storage battery and engine-generator can team up. The battery would be sized to carry the EDP load for a short term, leaving ample time to manually start the engine-generator. If you're considering this arrangement, study the feasibility of including critical air conditioning in engine-generator sizing.

Uninterrupted - power sets shown above are seeing computer service where continuous operation is a must. Typical is the recent installation in an air-traffic-control center. Here, in addition to assuring electric-supply continuity, the diesel-generator set converts 60-cycle input to the 420 cycles the computers need. For more detail on power supplies, see POWER, May 1960, pp 74-75.

Tomorrow's systems will benefit from a sure-to-come stepped-up study program on the part of computer manufacturers, utility companies and EDP users, encompassing the problems of coping with or eliminating transients and power interruptions. Some computer suppliers have in the past placed the problem of input-power impurities smack in the customer's lap. Many utility companies have lagged in realizing the importance of electric purity when feeding computer loads. And too many energy-systems engineers have placed EDP equipment in the category of "just another load" when designing their electric-distribution systems.

Quality of electric supply might well be improved by both utility and the energy-systems designer who represents the computer user. And computer-power-supply designers must increase the tolerance of EDP equipment to more realistic input values. Then, many of the problems computer owners now wrestle with will be definitely eased, even eliminated.



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NEW
Decentralized system includes battery of six generators in existing powerhouse producing 125-psig steam. Operating area has space for two additional units in future

OLD
Boiler room with five coal-fired boilers, now idle, handled entire steam load. This room plus ash-handling and coal-storage space will be available for other plant use

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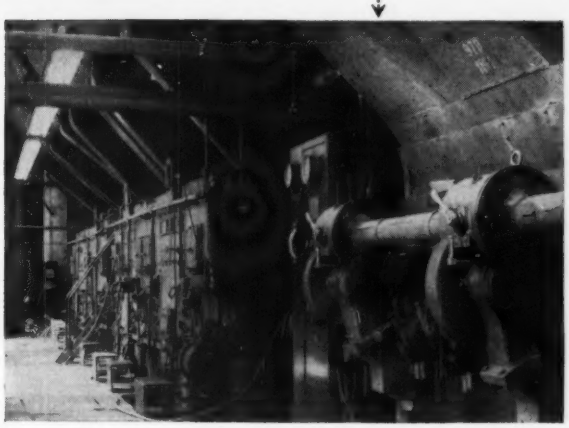


Decentralized steam system cuts operating costs

By R H MARKS, Associate Editor

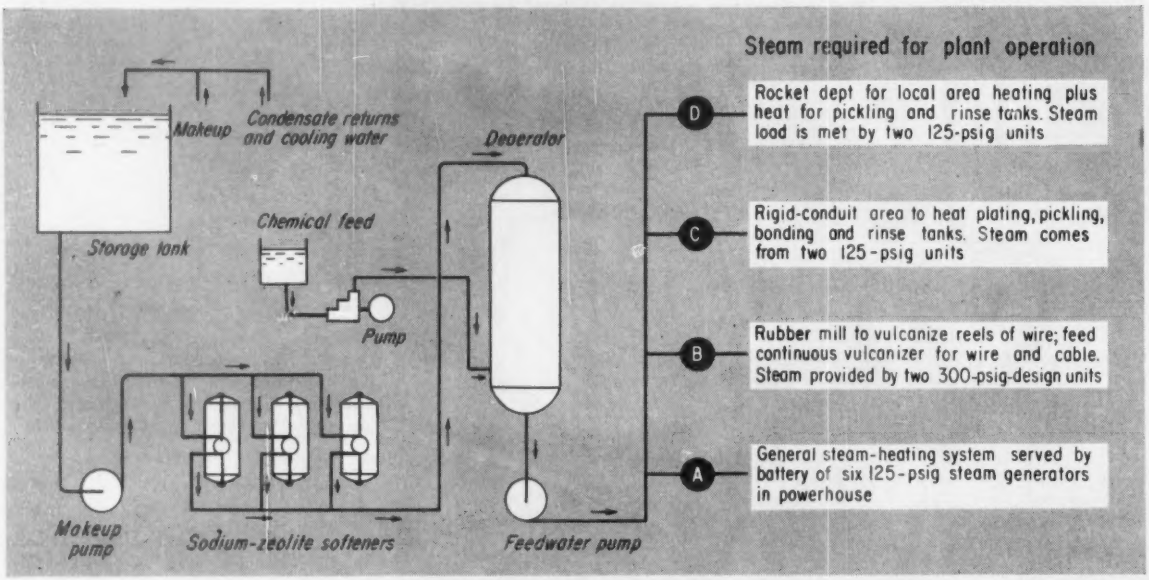
Firing only those generators needed to meet steam demand ups plant efficiency. Automatic oil-gas operation reduces manpower

In the face of today's growing trend to centralize many energy systems, one manufacturing plant selected a *decentralized* system to modernize their existing steam-generating facilities. According to M Lang, Maintenance Supt of H K Porter Company Inc's National Electric Division (electric-distribution products) at Ambridge, Pa., the new system will save more than $100,000 a year.

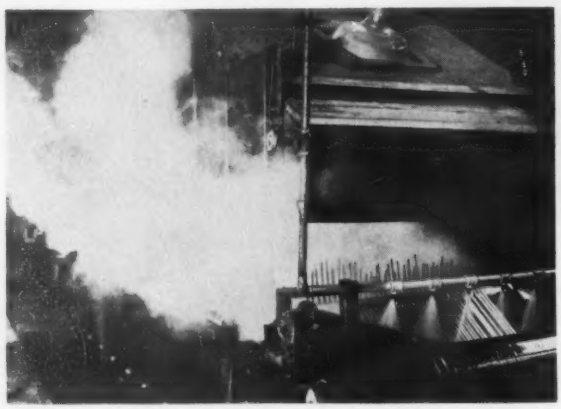
Flow diagram, next page, divides steam consumption for process and heating at this plant into four major areas. Five coal-fired boilers at a central powerhouse formerly generated steam to meet all these needs, and mains carried it to point of use. Condensate returned from widely scattered areas throughout the plant and dropped into an open storage tank just outside the powerhouse. There it mixed with some cooling water and makeup before entering the central water-treatment plant. But mounting maintenance charges and other problems that go with operating boiler equipment that is both outmoded and old called for a complete revamp of the steam-generating system.

Total process load is calculated at about 13,500 lb per hr. To meet this demand the central system supplied over one-half-million lb of steam per day for an average rate of about 21,000 lb per hr. Difference in these two rate figures is accounted for by such items as steam to heat feedwater, drive stokers and the vacuum pump plus radiation and other system losses. Actual process-steam demand is only about 215,000 lb for typical 2-shift 16-hr operation.

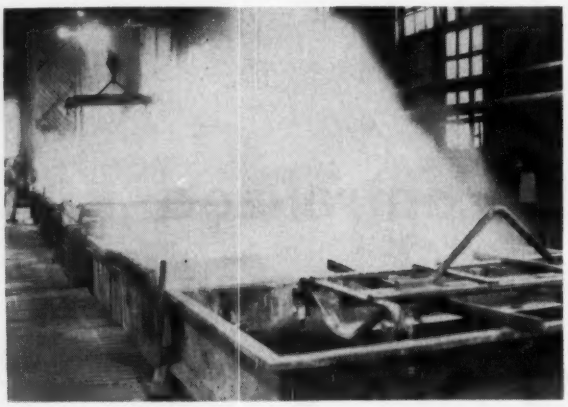
continued


Steam required for plant operation
Rocket dept for local area heating plus heat for pickling and rinse tanks. Steam load is met by two 125-psig units
Rigid-conduit area to heat plating, pickling, bonding and rinse tanks. Steam comes from two 125-psig units
Rubber mill to vulcanize reels of wire; feed continuous vulcanizer for wire and cable. Steam provided by two 300-psig-design units
General steam-heating system served by battery of six 125-psig steam generators in powerhouse
D
C
B
A
Makeup
Condensate returns and cooling water
Deaerator
Storage tank
Chemical feed
Pump
Makeup pump
Sodium-zeolite softeners
Feedwater pump

STEAM DEMAND is met by packaged generators installed near point of use. Existing softeners and deaerators supply treated makeup



CONTINUOUS GALVANIZING of flexible conduit calls for steam to initially heat and keep rinse water at near-boiling temperature



PROCESS-STEAM demand from pickling, plating and rinse tanks, including steam for vulcanizing rubber, totals 13,500 lb per hr

So there was considerable room for improvement in overall efficiency.

Merits of replacing with another central steam system embodying modern coal- and ash-handling equipment got careful consideration. But many aspects of the problem, some of which are common to older manufacturing plants, made a decentralized steam system most attractive in this instance. Five major changes in the existing system account for most of the astonishing jump in operating efficiency—from 65 to 80%.

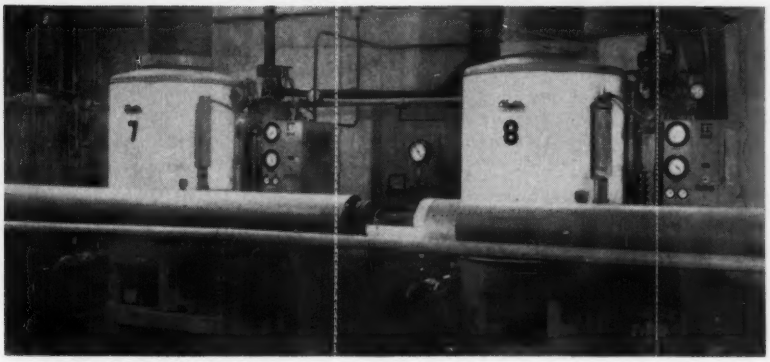
First: The process-steam supply is now located close to where steam is used. This reduces heat losses by readily permitting return of condensate to each generator at elevated temperatures. Continuous-vulcanizer condensate from area *B*, above, can now be recovered around 363 F. Condensate from the rocket department, area *D*, is sent to steam generators at the 298-F level. In addition, heat loss from steam and condensate lines running back and forth from central powerhouse is eliminated. All this heat saved directly reduces amount of fuel needed to furnish steam.

Second: Only those generating units needed to meet steam demand are fired. This makes it possible to closely match steam production with process-steam demand. Costly radiation losses are kept at a minimum since it is no longer necessary to operate large boilers at greatly reduced capacity. Operating flexibility of the new system is expected to keep overall efficiency (steam used to fuel fired) at a minimum 80% compared to 65% efficiency for the old centralized system.

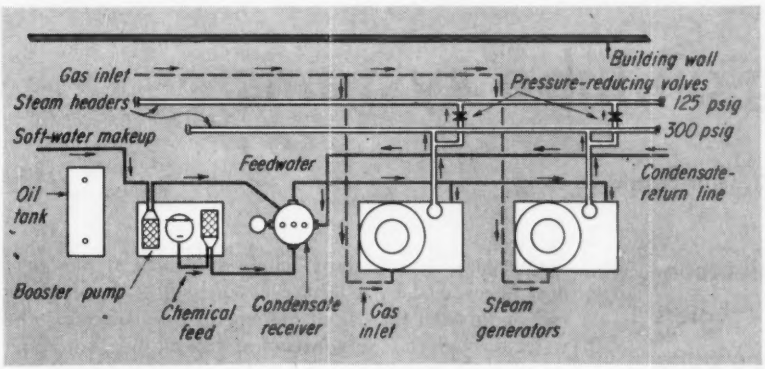
Third: Decentralized system allows complete shutdown over weekends and holidays during the summer months. Installed steam capacity is ample to meet startup demands.

Before, the powerhouse boilers had to be fired on Saturdays and Sundays in summer. This is standard for large firebox units—allowing a boiler of this type to cool each weekend with subsequent refiring when needed creates more operating prob-

Process condensate is now recovered at high heat levels



CONTINUOUS VULCANIZING goes on in large pipe running past units supplying steam



STEAM-GENERATOR layout provides for local recovery of high-temperature condensate

Each battery of steam-generating units makes up a complete system meeting steam demands in its immediate area. System at left supplies 125- and 300-psig steam to vulcanize wire and cable on continuous-vulcanizing line.

Soft deaerated makeup is delivered by the central water-treating plant. Then it's picked up by a booster pump and discharged to condensate receiver in response to liquid-level change. Chemical feed adds small amounts of phosphate and sulfite to remove residual hardness and dissolved oxygen. With this arrangement process condensate is returned to generators at maximum temperatures to improve efficiency.

Each steam generator consists basically of pump, coil, burner and accumulator. Feedwater from condensate receiver is pumped to the accumulator. Circulating pump takes suction from accumulator and pumps water through heating coil, in counterflow to combustion gases passing over outside of tube. Water leaves at a controlled temperature and enters accumulator through a water-separating nozzle. Part of the water flashes into steam and exits through the top of the accumulator to the steam main. Remaining water recirculates to heating coil. Automatic blowdown from accumulator controls the total dissolved solids.

lems than it solves. Increased maintenance alone comes to more than the cost of extra fuel to keep boilers continuously on-line.

But the new system can shut down completely any weekend or holiday when building heat isn't needed. Plant operating records reveal that weekend firing during May, June, July, Aug and Sept consumed about 3900 tons of coal. Almost all this expenditure can now be classified as an operating saving.

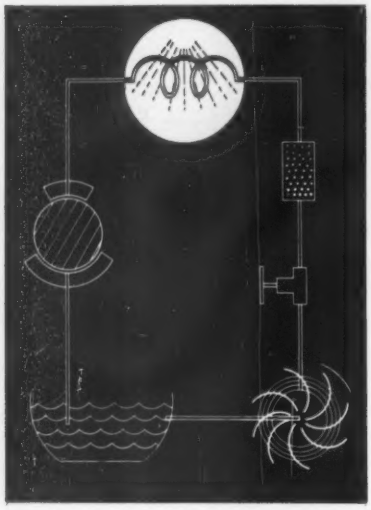
Fourth: Automatic firing with oil or gas greatly reduces operating labor needed for the steam-generating system. Old central system called for 17-man total to run the five boilers, engines, compressors and related equipment in the powerhouse. Experts estimate that 12 men would be enough for a new central coal-fired plant with modern coal- and ash-handling facilities. But the decentralized oil-gas system actually installed is expected to do an effective job with just 8 or 9 operators. Favorable natural-gas rate that averages 53¢ per thousand cu ft also helps make gas a desirable fuel at this location.

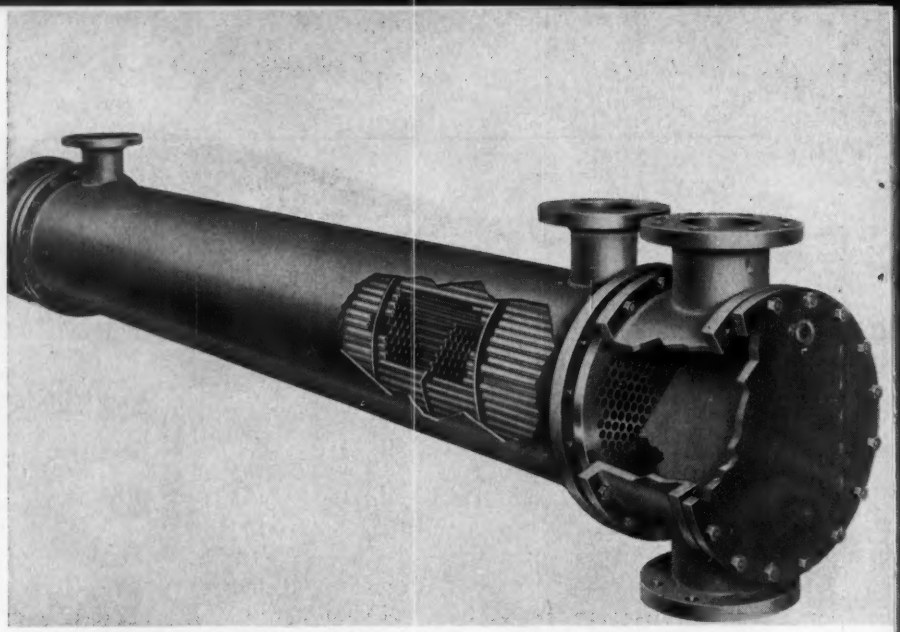
Finally: Retiring the central boiler system and switching from coal to gas and oil releases valuable space for other productive uses. Existing plant is located in an area where there is practically no space available for future expansion. But the old coal-storage area alone now provides 20,000 sq ft of open space. For now, this will be used to stash away inventory or finished products; in the future it may house a new substation, should one be required to handle increased plant electric loads.

Outstanding dividends of steam modernization at this plant demonstrate the value of a sound engineering approach. Modernization of energy systems can be a very profitable area for the alert plant engineer.

POWER wishes to thank R A Helsing, Plant Engineer, M Lang and C Bickhouse, Powerhouse Foreman, for their generous help in supplying data. Also helpful were Fred Wilson of R Munroe & Sons Mfg Corp and Neal Ballingall of Clayton Mfg Co.

LUBE—part 4





HORIZONTAL, DOUBLE-PASS COOLER has both water connections at one end. A header or channel at other end reverses the flow (alternate designs use U-shaped tubes)

COOLERS for circulating-oil lube systems

By E R BOOSER and D A SMEATON, General Electric Company

A vital part of the system's oil-reconditioning equipment, lube-oil coolers take out heat created by operating losses. They restore oil to its design viscosity for proper bearing lubrication

In earlier parts of this series, we covered some general system considerations and began detailed discussions of circulating-oil lube-system components—first reservoir design (June, pp 98-100), then piping (August, pp 91-93). Now we come to the first of the components that recondition oil as it circulates—the cooler.

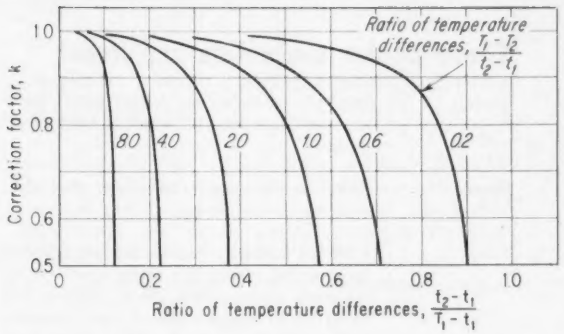
Keeping correct oil temperature is basic to operation of any lube system. Rate of deaeration, ease of purification, bearing performance, oil life and flow rates all directly relate to oil temperature. While tubular heat exchangers can be used to either warm or cool lubricating oil, cooling is far more frequently a major problem. There are so many ways oil can pick up heat: from bearings, pumps, seals and gears; from friction losses in piping, fittings and orifices; from hot machine elements.

Various plate, fin and tube cooling arrangements find use in small circulating-oil systems, but almost all larger systems use a shell-and-tube heat exchanger. In both single- and double-pass designs, water flows through tubes which are surrounded by oil confined within the shell. In double-pass coolers, water enters and exits at one end; flow is reversed by a header or channel at the opposite end or through the use of U-shaped tubes. Directing the water through the tubes instead of around them simplifies cleaning. Cooler above is typical of a horizontal unit.

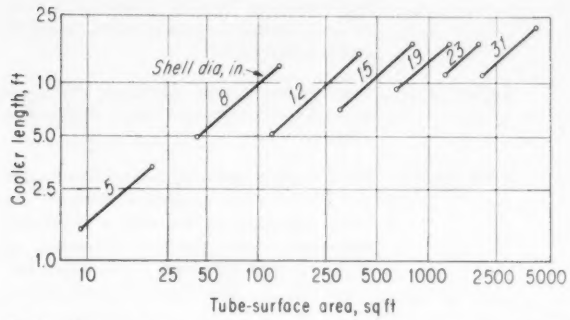
Cooler design starts with required heat-transfer area. First step is to get proper Δt_m—effective log-mean-temperature difference. To do this you can use the formulas, above right. In a single-pass counterflow cooler, formula (1) applies directly, but be sure to keep temperatures straight. However, if your cooler is double-pass or U-tube type pick a correction factor from chart 1 and use formula (2) to adjust effective log-mean-temperature difference. Then go to (3) and solve for required area.

This will give you an idea of the tube-surface area you're working with, but design details influence heat-transfer rates to such an extent that final selection had better wait until you've talked to your cooler manufacturer. Higher flow velocities, for instance, give higher pressure drops with increased heat-transfer rates, and this tends to lower both size and cost of the cooler. A greater differential between oil and water temperatures also allows a smaller, lower-cost cooler; finned tubes, where they can be used, boost heat-transfer rates. On the other hand, abnormally dirty oil or cooling water cuts heat-transfer rates and demands larger coolers. Baffle and tube-bundle arrangements, too, affect heat-transfer coefficients.

An example will illustrate our approximation method. A gas-turbine system using light turbine oil needs 1,080,000 Btu per hr removed while cooling 225 gpm of oil to 130 F. Water inlet temperature: 95 F. Taking oil's heat



1 Correction factor adjusts log-mean-temperature difference for double-pass cooler designs. Be sure to use the right temperatures



2 Double-pass shell diameters are based on cooler length and needed surface area. Longest possible cooler holds down cost

Cooler-design formulas you'll need

Effective temperature difference for single-pass coolers

$$\Delta t_{lm} = \frac{(T_1 - t_2) - (T_2 - t_1)}{2.3 \log \frac{(T_1 - t_2)}{(T_2 - t_1)}} \quad (1)$$

Corrected temperature difference for double-pass coolers

$$\Delta t'_{lm} = k \times \Delta t_{lm} \quad (2)$$

Heat-transfer surface needed (use Δt or $\Delta t'$)

$$A = \frac{Q}{U \times \Delta t_{lm}} \quad (3)$$

Oil-temperature difference

$$\Delta T = \frac{Q}{G \times 3.5} \quad (4)$$

Cooling water needed

$$G = \frac{Q}{\Delta t \times 8.33} \quad (5)$$

A = total tube area, sq ft
G = oil or water flow, gph
k = correction factor for double-pass coolers
Q = total heat transfer, Btu per hr
T = oil temperature, F (subscript 1 = in; 2 = out)
t = water temperature, F (subscript 1 = in; 2 = out)
Δt_{lm} = log-mean-temperature difference, F, for single-pass coolers
$\Delta t'_{lm}$ = log-mean-temperature difference, F, for double-pass coolers
U = overall heat-transfer coefficient, Btu per sq ft per hr per deg F

capacity at a typical value of 3.5 Btu per gal per deg F, temperature drop in the oil going through the cooler will be 23 F, from formula (4). If we use a double-pass cooler, have a permissible water-temperature rise of 10 F and our 23-F oil-temperature drop, $\Delta t'_{lm}$ from formula (1) corrected by formula (2) comes out to 40.

Let's assume an overall heat-transfer coefficient of 60 Btu per sq ft per hr per deg F. This value usually falls in the range of 50 to 60, but sometimes goes as high as 80 to 100 for light turbine oils. For heavier gear oils, 25 to 40 will be more accurate.

From formula (3) we get a required heat-transfer surface of 450 sq ft. We need 216 gpm cooling water, from formula (5), and want to hold water velocity below 8 fps to prevent abnormal tube erosion.

Once total tube area has been established we can figure out shell size and tube arrangement. Heat-exchanger tube lengths range from about 1 to 20 ft. But remember that unit's *overall* length is greater than the tube length by that space needed for the headers—from a few inches to 3 ft or more in larger coolers. And don't forget to allow some free space beyond the cooler so you can pull tube bundles for cleaning. Free space should measure slightly more than the length of the tubes less header length.

Shell diameter varies from only 2 in. for small coolers up to 4 ft or even larger. For economy's sake, select the smallest shell diameter consistent with permissible pressure drop. Naturally, this basis of shell selection points toward long, slender coolers, but practical considerations frequently limit length to 12 to 13 ft (10-ft tube). Diameters in chart 2 are typical for double-pass coolers.

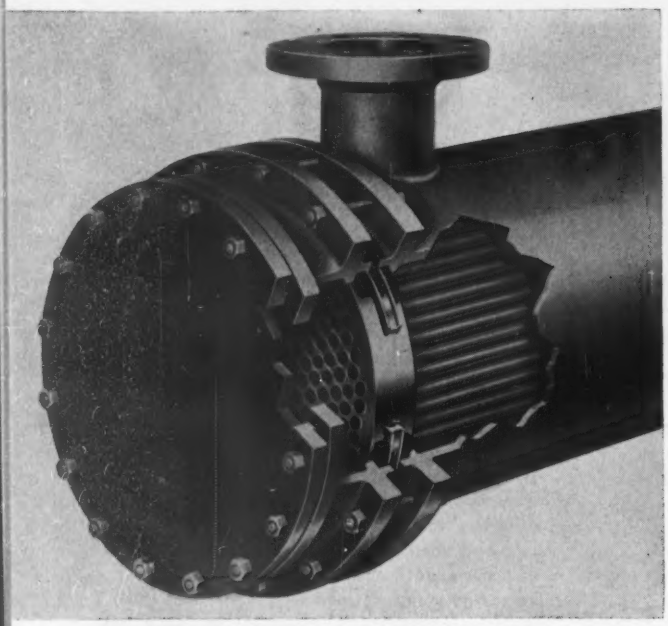
To go back to our example, we needed 450 sq ft of transfer area. So for preliminary purposes, it would be logical to select a 15-in.-dia cooler 10-ft long from chart 2. Again these dimensions will vary with pressure drop, tube arrangement and number of cooling-water passes.

In either single- or double-pass coolers (but not in U-tube designs) the tube sheet at one end of the cooler is left free to float and compensate for differential thermal expansion of tubes and shell. The stationary head can be removed from the stationary tube sheet and shell to get the tube bundle out for cleaning and repair.

If cooling water is salty, a zinc electrode or plate can be installed in one header to provide galvanic protection and minimize tube corrosion.

Baffling, sectional or segmental, leads hot oil to intimate contact with tube surfaces along their entire length. For low oil velocities, alternating ring and central-disk baffles are popular. The baffles in most coolers are spaced about 4 to 14 in. apart. Usually about 20% of the otherwise circular baffle plate is cut away to allow oil flow, but as much as 65% may be cut away where low pressure drops are a must or where baffles are widely spaced. Baffle-opening sizes are matched with baffle spacing to produce constant oil velocity of 2 to 8 fps both along and across the tubes (of course, larger baffle openings and wider spacings cut pressure drops for higher flow rates). So that tubes can be drained easily for repair, baffles are notched along the cooler bottom or cutaway portions are arranged at an angle up to about 45 deg.

Baffles serve another purpose; they double as tube supports. If this suits the design, flanged lips around each



FLOATING TUBE SHEET with telltale gland in the flow-reversing head of this double-pass cooler allows for thermal growth

These cooler materials are usual

Shell	Steel pipe or rolled and welded plate. Seamless red brass may be used for some small coolers
Heads	Cast iron, fabricated steel plate, steel pipe, cast steel or cast bronze
Tubes	Inhibited admiralty is most popular, followed by arsenical copper. For better resistance to sea-water corrosion and stress cracking, 90-10 or 70-30 copper-nickel is also common. Al-brass, Al-bronze and plain aluminum are gaining. In each case, water conditions determine optimum materials. Finned tubes increase surface area. Fins may be formed from the surface of a thick tube or fabricated separately and tinned or soldered to the tube
Baffles	Brass, bronze or steel. Aluminum baffles are used only with aluminum tubes; steel is also satisfactory here
Tube sheets	Muntz metal, admiralty, rolled naval brass and 90-10 copper-nickel are common. Al-bronze handles more and more of the higher temperatures and pressures. Aluminum is used only with aluminum tubes; steel, too, is used for the tube sheets of some coolers

baffle hole are desirable to give a larger tube-support area. Tubes are roller-expanded into tube sheets for a leak-proof fit, and close fits between baffles and cooler shell prevent oil from short-circuiting.

Tube size is matched to cooler diameter; smaller tubes provide larger surface area in a given cooler size. On the other hand, smaller tubes raise your cost, and they may drop water pressure excessively. A balance of such factors usually leads to selections like these:

Tube dia, in.	*Shell dia, in.*
3/8	6 to 10
1/2	8 to 15
5/8	12 to 36
3/4	20 and up

Actually 5/8-in. is a popular tube size for some of the largest oil coolers made. Extremes would be 1/4-in. tubes, occasionally used in very small coolers, and 1-in. tubes finding limited application in the largest sizes. Tubes any larger than that are impractical to arrange without overfilling the shell and blocking the oil-passage area.

Triangular-pattern tube arrangement squeezes in the maximum number of tubes. And by breaking up the oil flow, a triangular pitch promotes better oil mixing and higher heat-transfer coefficients. So a square-pitch tube pattern is used only on rare occasions: where easy cleaning is a must, with very heavy oils or where pressure drop must be severely limited.

Tube spacing should be close for minimum size and low cost but it must still allow adequate space for oil passage, maintain sufficient strength in the web of tube sheets. Center-to-center spacing of 125% tube diameter is normal. With 5/8-in. tubes, for instance, 25/32-in. centers are common, giving 5/32-in. spacing between tubes. But if space is at a premium you might drop this to 1/8 in.

Straight-through tubes are preferred for easy cleaning, especially with raw cooling water. But with clean condensate, U-tubes are frequently found in vertical coolers mounting directly in oil reservoirs.

Cooling is the usual duty for heat exchangers in circulating-oil lube systems, but they sometimes are used as heaters, too. For example, oil must be preheated to reach correct viscosity in steel-mill operations as well as outdoor installations in cool climates. And some purification systems operate at elevated temperatures. These heating systems are not standardized, so you should check handbooks on heat transfer to select steam coils. If electric heating is used, be sure you don't get units intended for water heating—their heat flux is enough to carbonize oil.

After long operation, cooler capacity often drops because scale and dirt accumulate on cooling surfaces, cutting tubes' cooling efficiency. Waterside deposition is usually faster and affects performance more, so waterside cleaning is apt to be needed more frequently. It's time to clean when a water flow must increase substantially to hold required temperature drop in the lube oil.

Sometimes mere flow reversal is all that's needed to restore normal cooling capacity. In vertical U-tube coolers further partial cleaning is possible without drainage: remove the top cover and use an air lance to break up dirt throughout entire tube length. A fiber-bristle brush does the same job. Then boost flow to a higher-than-normal rate to flush the tubes; quick flow reversals also help.

For more complete cleaning of the waterside, coolers should be entirely drained of water and oil and the tube bundle removed. Steam cleaning or flushing with an inhibited acid does a thorough job, but be careful to match acid with tube materials to avoid corrosion.

9 points your cooler manufacturer has to know

1. Heat load to be removed from oil, Btu per hr. You'll usually base this value on experience. But if not, add power losses in bearings and oil pumps to hydraulic losses in pipe and fittings. Then correct your total for heat transfer in the rest of the lubrication system
2. Maximum temperature of oil to cooler—probably about 130 to 150 F
3. Grade of oil used
4. Flow rate of oil
5. Operating pressure for both oil and cooling water
6. Allowable pressure drops for both oil and cooling water. Usual maximum oil-pressure differential for steam-turbine oil coolers is 6 to 12 psi; in other systems, a range of 10 to 15 psi is not uncommon. Water-pressure losses run from 2 to 5 psi. In closed cooling-water systems, pressure drop is generally kept within limits imposed by other needs of system components
7. Cooling-water cleanliness and corrosion characteristics. These affect cooler materials, while water hardness is a factor in basic cooler design
8. Cooling-water inlet temperature. 90 to 95 F is a conservative value for river or sea water. Temperature may go up to 135 F in closed systems using cooling towers or other heat exchangers
9. Mounting arrangement—will cooler be vertical or horizontal—where do the inlet and outlet connections go—what space is available?

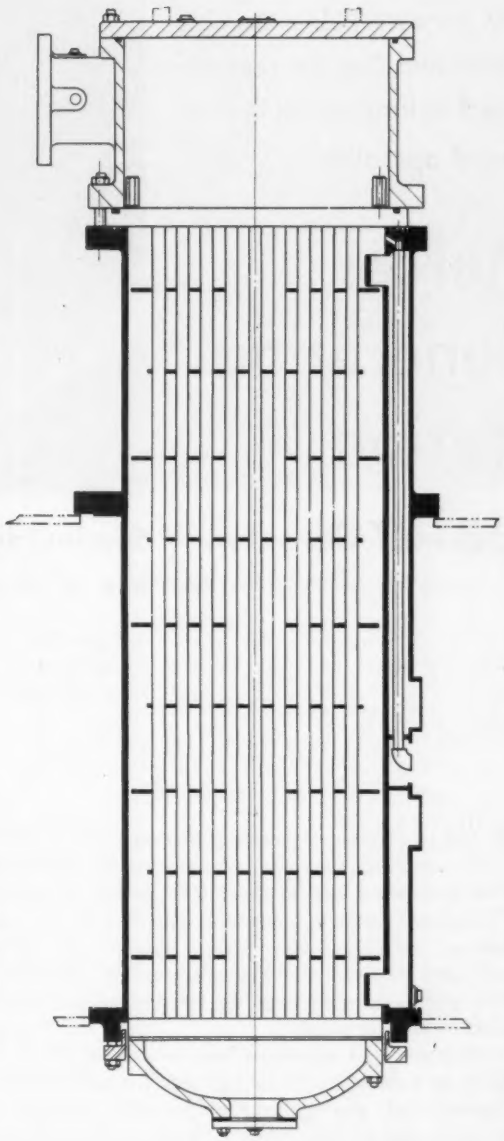
On the oil side, usual cleaning agents are hot water, steam, petroleum spirits and flushing oil. Alkali cleaners may not be a good idea because they sometimes remove oxide from tube surfaces, exposing bare copper which catalyzes oil oxidation. Regardless of the cleaner used, remove all traces to prevent oil contamination.

Tube leaks will show up differently depending on relative oil and cooling-water pressures. If water must be kept out of the oil system, oil pressure should be the higher of the two. Then abnormal drop in oil level shows up a leak. When the oil side is kept at a lower pressure, a water detector in the oil reservoir will indicate leakage. To check out a possible leak, drain all water and remove the head. Then apply oil presure and look for leaks.

A few isolated tubes can be plugged temporarily with tapered maple or plastic plugs driven into each end. But when tube failures impair cooler performance too much, you should have the manufacturer retube the bundle. Double-pass coolers with floating heads are usually designed with some way to detect leakage past the floating tube-sheet packing. Any leakage noted can usually be stopped by tightening the cover.

If complete cooler shutdown is going to be too costly or impractical—on a continuous-duty turbine-generator, for example—install two coolers in parallel. Transfer valving lets you keep one cooler in service while isolating the other for cleaning or tube replacement.

Later articles in this series will cover other lube-system components, control and maintenance.



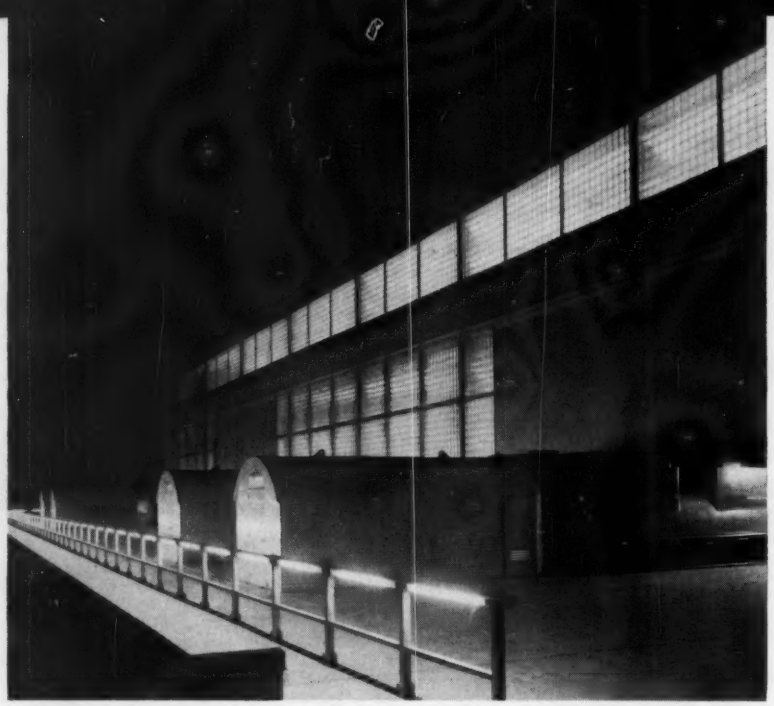
Vertical cooler saves space

Increasingly complex cooling systems put space at a premium. One good way to save some room: mount a vertical cooler right in the oil reservoir. In addition to space saving, piping is simpler. Appearance is neater, too.

In the turbine-generator cooler above, vent connections and both oil inlet and outlet ports terminate within the reservoir itself. Water connections are of course on the outside, and the water-return header extends through the reservoir bottom. This setup lets you completely disassemble the cooler without breaking the seal between shell and reservoir.

New Jersey's Public Service Electric and Gas Co recently placed its largest unit in commercial operation

Mercer Generating Station features . . .



Semioutdoor construction with extensive use of aluminum throughout

To save first cost, generators, boiler-feed pumps, their variable-speed drives and speed-increasing gears are outdoors. Pumps and drives are weather-protected by a removable shed. Station construction uses a lot of aluminum to cut maintenance

Unit 2 of the Mercer Generating Station went into commercial operation in June; it's the largest and most modern generating unit in the Public Service Electric & Gas Company System. Consistent with Public Service's pioneering tradition, many design features are spotted around this new station. These are not novelties, but natural evolutionary steps in the continuing progress of steam-electric generation.

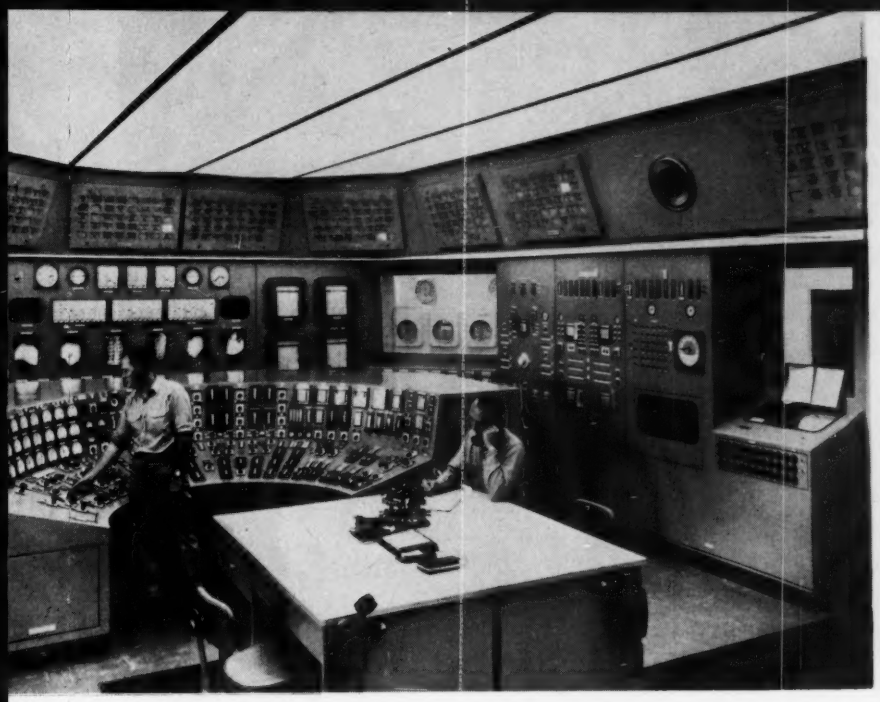
But before we go into these features let's take an overall look at the station. Twin furnaces for each unit fire pulverized coal, gas ignited; they're also designed to burn interruptible gas. Two 320-mw cross-compound turbine-generators operate at throttle conditions of 2400 psig, 1100 F, with reheating to 1050 F. Once-through condenser circulating water comes from the Delaware River.

Operating experience to date has been most satisfactory. In fact, heat rates attained during this startup period forecast that the Mercer Generating Station will soon join the elite circle of our most efficient steam-electric plants. Example: During August of 1961 the two units hit an average generation of 602 mw with a heat rate of 8996 Btu per kwhr. And this was operating with 75- to 80-F condenser cooling water resulting in condenser vacuum of 28-in. Hg or less. Some weekly heat rates logged during September have shown values as low as 8636 Btu per kwhr based on an average unit generation of 310 mw, 97% service factor, 100% duty factor. Projecting ahead into winter months with colder river water, very enviable heat rates would seem likely.

Pioneering design features characterize this station. Semi-outdoor construction saved real dollars in first cost. But designers had to take into account the probability of severe winter weather. So Public Service kept the turbines themselves indoors but allowed the generators, boiler-feed pumps and their drive components to extend through the station wall and onto an outdoor platform. But what about winter maintenance on pumps and drives? Removable metal sheds cover these components and provide working space for minor maintenance. A 15-ton crane inside the shed itself permits disassembly of any component. For major maintenance, a 50-ton semi-gantry crane lifts off the shed, above right, and is used to disassemble feed-pump drive and remove the generator field.

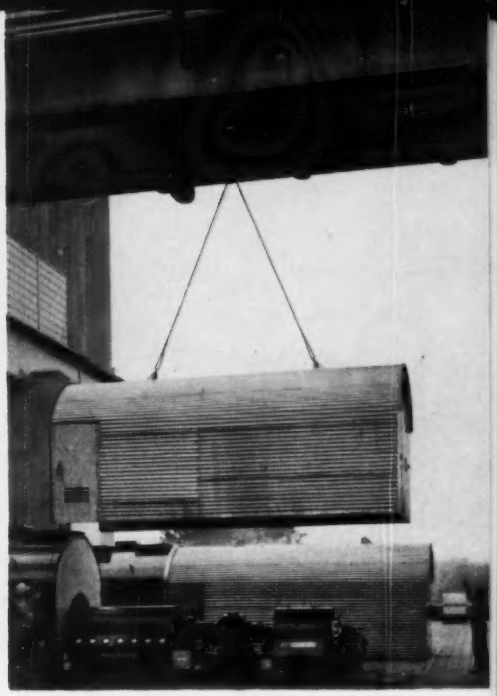
Aluminum is employed to a large extent throughout the Mercer Generating Station—structurally, mechanically and electrically—and brings many benefits. The semi-gantry crane features complete aluminum construction, as do station bus bars and most window and door frames and building trim. Deaerated-water storage tanks are all-aluminum, too. In the switchyard, all buses are built of electric-grade welded tubular aluminum and all terminal frames and supporting structures are fabricated from 6061-T6 aluminum alloy. Transmission towers leaving the station from Unit 2 are also aluminum. In most cases the decision to use aluminum so extensively was based on reduced cost of maintenance.

In line with Public Service's recent practice, high-speed half-capacity boiler-feed pumps are directly driven from the outboard end of the main generator shafts. Hydraulic



Central control room for both units with data loggers to monitor temperatures

Window, center, in station control room lets operators view direct-reading drum-level and pressure gages—h-p lines don't come into control room. Data logger, far right, scans 600 temperatures in Unit 1; duplicate equipment serves Unit 2



High-speed b-f pumps and epicyclic gears

In-line epicyclic gear between high-speed b-f pump and hydraulic coupling saves space, increases speed to 8986 rpm

couplings vary pump speeds to meet boiler demands throughout the station operating range. To back up these shaft-driven main boiler-feed pumps, each unit has a quarter-capacity motor-driven boiler-feed pump as well. It can sustain full boiler pressure running in conjunction with one of the two shaft-driven pumps; control is maintained by regulating speed of the shaft-driven pump.

Evolutionary step in this part of the plant is the drive arrangement. Instead of conventional parallel-shaft speed increasers, in-line-shaft epicyclic gears boost the speed from 3600 to 8986 rpm (see POWER, Oct 1960, pp 156-157). This use of epicyclic speed increasers on boiler-feed-pump drives is a first in the U.S. Similar epicyclic increasers serve the spare pumps and two 10,000-rpm centrifugal air compressors which supply soot-blowing and all other station air needs.

A central control room, located between the two main turbines, serves all control functions for both units. Extensive TV monitoring provides visual check on furnace firing conditions, boiler level, stack emission and the main station gate. All signals to indicators and controls are electrically or pneumatically telemetered. Direct-reading drum-level indicators and drum-pressure gages are located *outside* the control room and viewed through a window, in keeping with the philosophy of having no high-pressure lines inside the room itself.

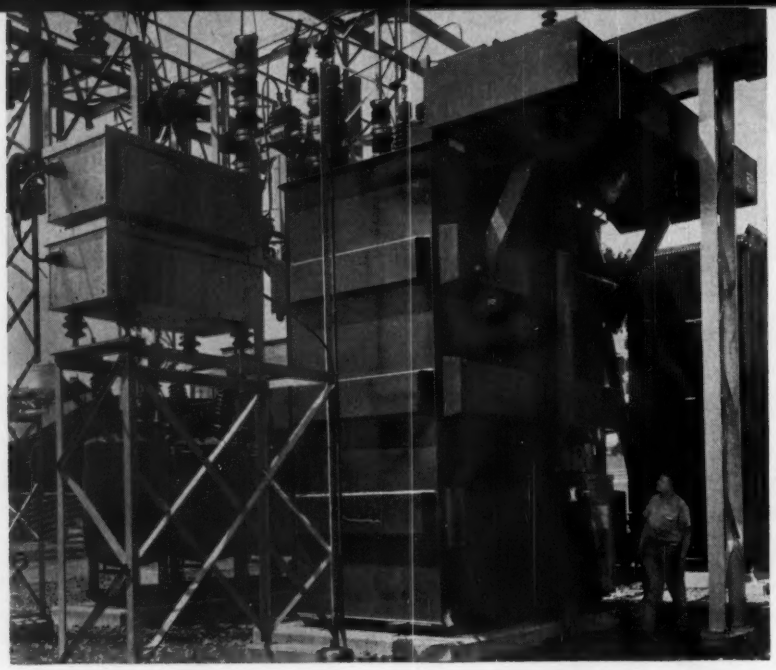
Data loggers provided in the control room keep operators informed on important temperatures in the plant. They can scan 600 thermocouple temperatures per unit and compare them with predetermined setpoints. When a value exceeds its setpoint, logger prints out the time, point and temperature in red and sounds an alarm.

Logger's trend function permits operators to select up to ten temperatures to be printed out (together with time) once each scan cycle. If the typewriter should be out of service, operator can manually select any particular temperature he wants monitored. Log function lets operators log out, on demand, all 600 temperature points.

Performance computer designed into the Mercer Generating Station is a digital, stored-program synchronous computer with 16,000-word capacity. It is capable of calculating and printing out station performance reports on a weekly, monthly, quarterly or yearly basis. When desired, the computer can perform operating tests on main equipment for any period the operator chooses. It also can provide continuous operating guides such as unit heat rate and boiler efficiency from which actual is compared to bogie operation. With these guides, the control set points can be adjusted by hand to optimize unit performance.

A 2-train demineralizer plant produces station makeup water. Each train consists of a cation unit and a strong-base anion unit followed up by a mixed-bed polishing unit. On exhaustion the entire train is removed from service and all units in it are regenerated at once. Design: 200 gpm of demineralized water with a quality not less than 0.2-ppm total dissolved solids, 0.01-ppm reactive silica, 0.05-micromho conductivity. During periods of low makeup, some condensate circulates through the demineralizer, to provide a degree of scavenging.

Reliability and smooth operation of your power transformers for years to come may hang on your choice of a . . .



INDUSTRIAL 30,000-KVA power transformer has a diaphragm-seal oil-preservation system

Transformer oil-preservation system

By G G DOUCETTE JR and R M GRIFFING, General Electric Company

Purchasers of power transformers—units rated above 10,000 kva—may have to choose an oil-preservation system. A special oil, used in most present-day power transformers, has superior insulation and heat-transfer properties. However, these advantages don't hold when oxygen and moisture get into the oil. Oxidation causes sludging which reduces cooling ability. Sludging and moisture both cut the dielectric strength sharply.

This is where the oil-preservation system comes in. Designed to eliminate or reduce air-to-oil contact, it, in effect, preserves the good qualities of the oil. In this way you're sure of efficient cooling and high insulation strength during the long life of your power transformer.

Five types of oil preservation in general use today are: conservator, sealed-tank, gas-oil-seal, automatic-gas-seal and constant-pressure systems, diagrams on next page. As is usually the case, there is no perfect method. Each system has its own advantages and disadvantages, summarized in the table on facing page.

Conservator system was introduced in 1916 and came into wide use. It is still used extensively in Canada and Europe. A conservator is an auxiliary, oil-expansion tank located at or above cover height immediately next to the transformer. As the oil expands and contracts because of thermal cycling, a connecting pipe lets it flow between the two tanks. This pipe is usually shaped like a gooseneck, forming a thermal block which keeps the oil in the conservator much cooler than that in the main tank. Moisture and oxygen are present at the surface of the oil in the conservator because it's in contact with the atmosphere, but only insignificant amounts of these impurities get into the main transformer oil. The thermal seal excludes most impurities in the transformer oil.

Let's sum up arguments for and against this system:

Advantages: Installation is simple and maintenance is easy; leaks soon show up as oil stains; *main tank* is low; main tank is under positive pressure so air and moisture can't get in if there's a leak.

Disadvantages: The conservator tank and relief pipe are tall and may interfere with incoming lines; high oil head could feed a fire through an oil leak in a broken bushing; oil in the expansion tank contacts air so poor oil can get into the main tank—although gooseneck does retard the interchange.

In the sealed-tank system, oil in the transformer covers core and coils but does not completely fill the tank. Remainder, generally 10% of the oil volume at 25 C, is an air space to allow for oil expansion. During normal operation of the transformer, only small changes in pressure occur in the gas space. In extreme conditions, relief valves vent or admit air when operating-pressure limits are reached.

Let's list some of the pros and cons of this system:

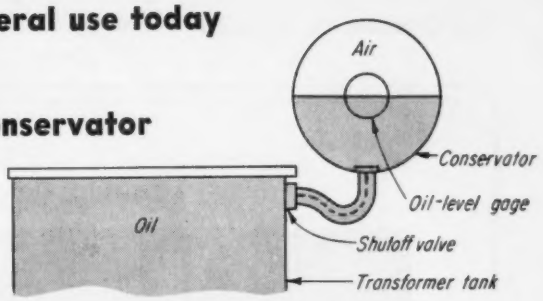
Advantages: Installation and maintenance are simple and easy; oil is completely isolated from atmosphere during normal operation; there's no interference with incoming lines. Setup is lightweight; "gas cushion" provides benefits which we'll discuss later.

Disadvantages: Some variation in gas pressure occurs; a taller tank may be necessary; leaks above oil level are

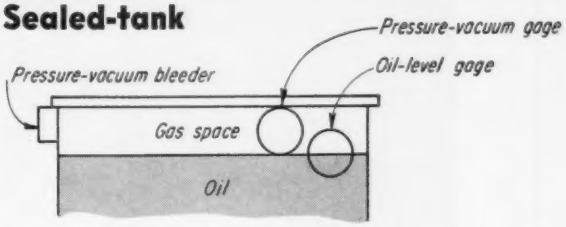
These five preservation systems are in general use today

Properties	Conservator	Sealed-tank	Gas-oil seal	Automatic gas seal	Constant pressure
Advantages					
Ease of installation	•	•	•		•
Minimum maintenance	•	•	•		•
Oil stain indicates leaks	•				•
Low *tank* height	•				•
Positive pressure	•			•	•
Complete oil-air barrier				•	•
Gas cushion		•	•	•	
Disadvantages					
Possibility of gas bubbles		•	•	•	
Can feed fires	•	•	•	•	
Heavy	•		•		•
Interferes with conductors	•				
Added floor space	•		•		•

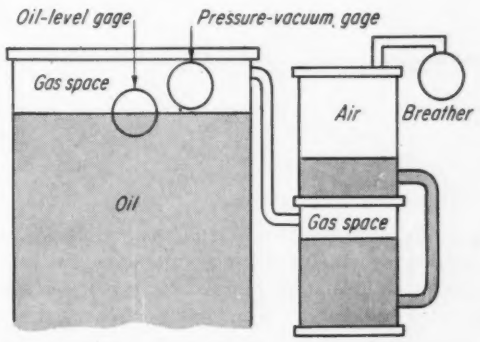
Conservator



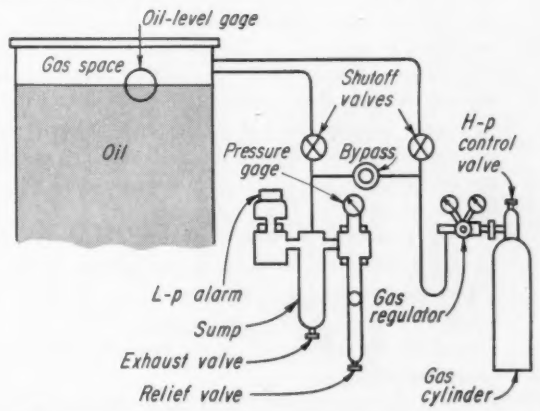
Sealed-tank



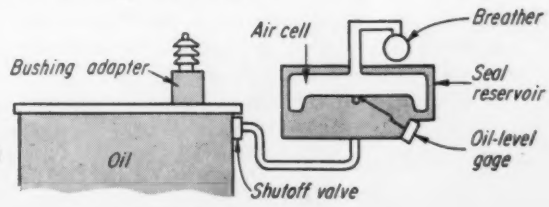
Gas-oil seal



Automatic gas seal



Constant pressure



not visible—you can only detect them by noticing continued zero reading of pressure gage; supersaturation can occur—we'll go into this later; water can be sucked in under vacuum; gas pressure can force oil through a broken bushing porcelain to feed a fire.

Gas-oil-seal system is least frequently used. Here transformer oil is isolated from the atmosphere by an oil barrier in an auxiliary tank beside the main tank. A gas space is maintained between transformer oil and oil barrier.

As in the sealed-tank system, small changes in pressure occur in the main-tank gas space during normal operation. In an emergency, gas is either expelled through the oil barrier in the expansion tank or air is sucked in via the same process.

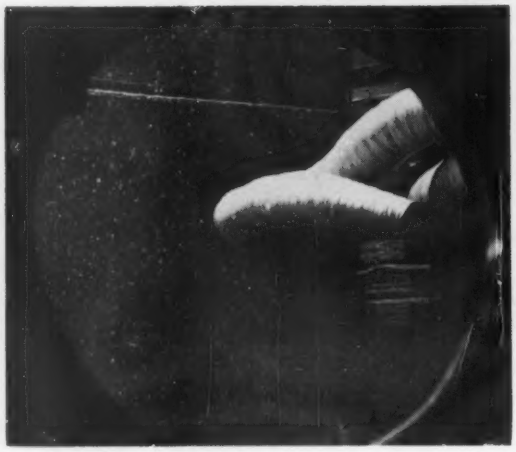
Advantages: Pressure variation is small, rate of contamination low; this system, too, has a gas cushion.

Disadvantages: Leaks above oil are indicated only by zero readings of pressure gage; tall tanks are needed; auxiliary tank takes extra space; gas pressure can force oil through a broken bushing porcelain to feed a fire; oil may supersaturate; water can be sucked in under vacuum.

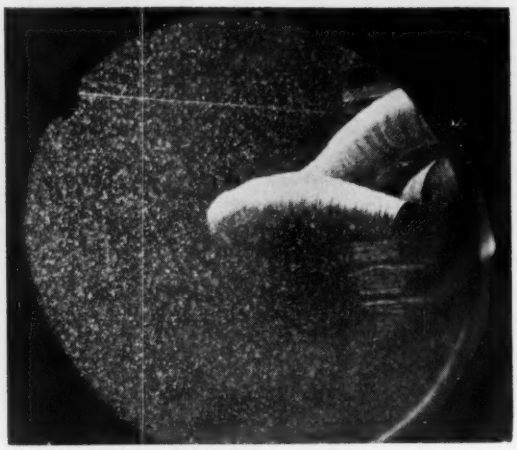
Automatic-gas-seal system uses an inert gas, usually nitrogen, in the space above the oil. A gas cylinder supplies the gas via a pressure regulator. In extreme conditions, nitrogen is expelled to the atmosphere or additional nitrogen admitted from the gas cylinder. Gas pressure commonly ranges between ½ and 7½ psig during normal operation.

Advantages of this system: Inert gas is always in con-

Looking through a special porthole in the tank we can



1 HR, 36 MIN—A few bubbles begin to show up



1 HR, 46 MIN—Light bubbling is noticeable

tact with oil at positive pressure—no moisture can enter provided the gas supply is absolutely dry; the gas cushion is there; under normal thermal cycling, water is removed from the transformer when gas is discharged.

Disadvantages: This is the most difficult system to install because of problems associated with getting gastight connections on the piping and hardware; you have no oil stains to indicate leaks; oil can become supersaturated; gas pressure can force oil through a broken bushing porcelain to feed a fire; this system has highest maintenance cost because you have to check regulating valves and replace gas cylinders (costs are estimated at $300 a year in a large installation); if a rainstorm suddenly cools the cover, residual moisture in the gas space can condense on the underside—then drops may fall into critical spaces in the transformers and cause failure.

The constant-pressure system, such as General Electric's *Atmoseal* method, is the newest comer of all. It's somewhat similar to the conservator system, but differences include a low, rectangular tank shape and a rugged Nitrile-rubber cell in the auxiliary tank as an oil-to-air barrier.

When this system was developed, designers paid particular attention to the physical and chemical characteristics of materials used in the air cell. After extensive tests, US-575 Buna-N rubber was chosen as most likely candidate for the parent material. Contamination tests at 120 C showed that neither cell nor oil was adversely affected by their mutual contact during the test.

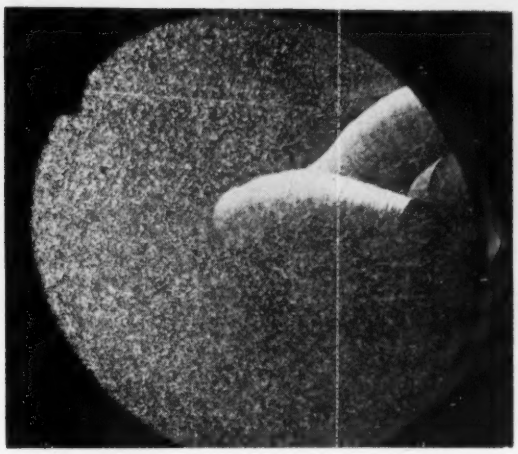
Advantages of the constant-pressure system: (1) Oil is not in direct contact with the atmosphere. The nylon-reinforced Nitrile-rubber air cell forms a seal between air and oil, drastically cutting oil oxidation and sludging rates. (2) Reservoir is low, so there's minimum interference with overhead lines. (3) Bushing and pressure-relief adapters keep oil from leaking in case of damage to either device. Adapters place each device above maximum oil level in the reservoir. (4) New system permits the use of a gas-detector relay. If gas develops inside a transformer because of an incipient fault, it can be collected and analyzed. This early warning of possible trouble helps prevent major failures. (5) Constant-pressure feature prevents the oil from forming bubbles even with sudden large changes in ambient temperature. (6) The system is simple to install, with practically no maintenance.

Disadvantages of this system include: heavier installed weight; slightly greater floor space needed (although there's no interference at ground level).

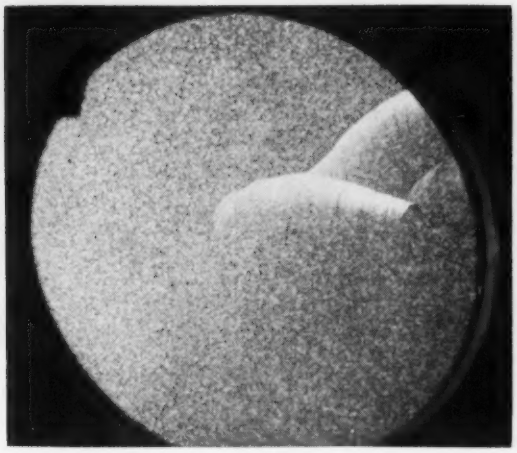
Evaluation of many of these advantages and disadvantages is readily made by the user. But other factors are not so straightforward and deserve clarification.

Gas cushion used by many of the systems has long been considered a protection against tank rupture in case of an internal fault. Recent tests show this is true only if the fault comes near the oil surface (see references at end of this article). Faults a few feet below oil level cause tank-wall deflections whose magnitude is not affected by the gas cushion, and faults are most likely to occur in the windings several feet below the oil surface. Primary safeguard against tank rupture is still the cover

watch bubbles grow in supersaturated transformer oil



1 HR, 52 MIN—Moderate bubbling indicates an increase



1 HR, 58 MIN—Heavy bubbling obscures the splice

pressure-relief device which is furnished on all makes and models of modern transformers.

Using a gas cushion introduces a hazard—bubble evolution. When a gas such as nitrogen contacts the oil surface under pressure at operating temperatures, enough gas is eventually dissolved to saturate the oil volume. Thermal circulation accelerates this process. Upon cooling, the oil becomes supersaturated. Under these conditions the solution is unstable, so gas can evolve because of pumping or electric stress, photos above. These gas bubbles cut the oil's dielectric strength to half its normal value. If they concentrate in areas of high stress, they can cause corona damage or even failure.

On the other hand, an all-liquid system such as the conservator or the constant-pressure system eliminates bubble evolution. Furthermore, it permits the use of a gas-detector relay—a simple gas accumulator collecting all the gases which evolve from the oil. By giving an alarm when a significant quantity of gas has accumulated, the detector provides continuous monitoring of the transformer's condition. Then accumulated gas is easily drawn off with a syringe. Since gas is undiluted, you can make a flame test to see whether it was produced by an incipient fault. If the gas burns, it is a product of insulation degradation caused by a fault. This warns of possible major troubles to come, lets you plan orderly corrective action.

Recently a system was announced for detecting traces of combustible gas on units with a gas cushion. This involves periodic gas sampling and analysis. But the new system does not have the automatic alarm feature of the gas-detector relay, which may turn out to be a disadvantage.

Standardization of transformers requires the manufacturer to select some oil-preservation system and base his design upon it. After considering advantages and disadvantages of each system, the General Electric Company has standardized as follows:

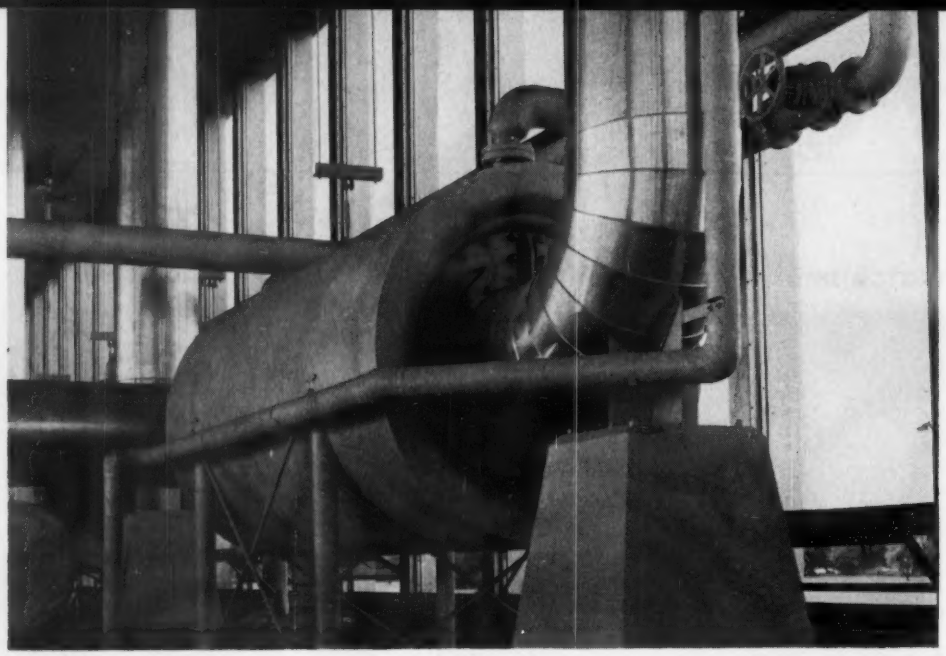
(1) In the range from 10,001 to 25,000 kva at 138 kv and below (operating voltage), the sealed-tank system is recommended. Units in this size range are often moved and put into new locations so the lighter weight and smaller floor space of sealed-tank units are highly desirable. Inherent low-maintenance feature is also a plus. Since these units are generally operated at lower voltages, oil supersaturation is not a major consideration.

(2) Above 25,000-kva and 138-kv operating-voltage level, the constant-pressure system is recommended. Safety and reliability are of prime importance with these large units, so it's vital to eliminate the supersaturation problem. The constant-pressure system does this better than any other. And this system is practically maintenance-free.

References

"Features of the *Atmoseal* oil-preservation system" by D R Baldwin, E J Sherman, R J Ringlee. AIEE *Transactions* Paper 58-859.

"Tank pressures resulting from internal explosions" by R J Ringlee and N W Roberts. AIEE *Transactions* Paper 49-1168.



WASTE-HEAT BOILER recovers a good hunk of the useful heat energy exhausted from one of several large sewage-gas engines. These horizontal boilers are installed in a West Coast sewage-disposal plant

Exhaust-heat boilers up diesel-plant efficiency

About 30% of input fuel heat goes out with the exhaust. Install the right recovery system, and you can pick up more than half of this heat as steam or hot water

By J C STEWART, Maxim Silencer Div, The J B Beaird Company, Inc (subsidiary of AMF Co)

As fuel costs creep upward, recovery of waste heat from internal-combustion engines gains interest and importance for energy-systems engineers. Just what is the potential here? Let's take a look at how available input energy is distributed in a modern i-c-engine power plant.

Useful work	33%
Rejected in exhaust	30%
Rejected in jacket water	30%
Lost through friction, radiation	7%
Total	100%

Rather dramatic gains can be made in overall thermal efficiency—*if* we can regain the wasted energy.

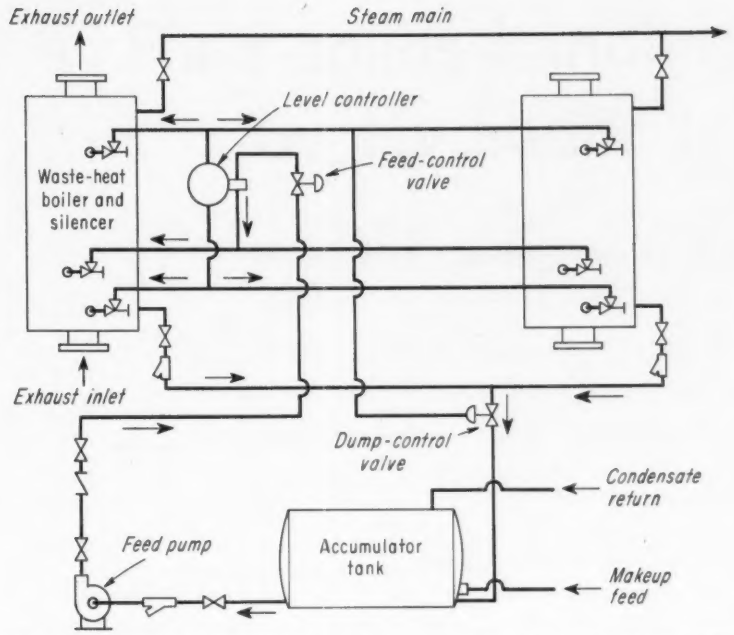
Of course, a standard or high-temperature cooling system can recover all the jacket-water heat. But only a portion of the exhaust heat can ever be saved. Inlet energy is based on inlet-air temperature of 70 F, but it would hardly be practical to reduce the exhaust to this temperature. DEMA (Diesel Engine Manufacturers Assn) sets a 250-F exhaust temperature as the minimum to avoid condensation in the system. To be on the safe side, 300 F is a good lower limit to use when designing an exhaust-heat-recovery boiler into your system. Even so, depending on initial exhaust temperature, you can recover 50 to 60% of your exhaust heat. On this basis a complete heat-recovery system, jacket water *and* exhaust, can up an engine's thermal efficiency from 33 to 75 or 80%—a rather nice improvement.

Since the exhaust is a relatively low grade of heat, large heat-transfer areas are required to recover its energy. Exhaust temperatures vary considerably, running from 450 F for some low-speed engines up to 1200 F for high-speed gas engines. Potential heat recovery is of course greater at higher temperatures. Quantity of recoverable heat can be figured from a standard heat-transfer formula:

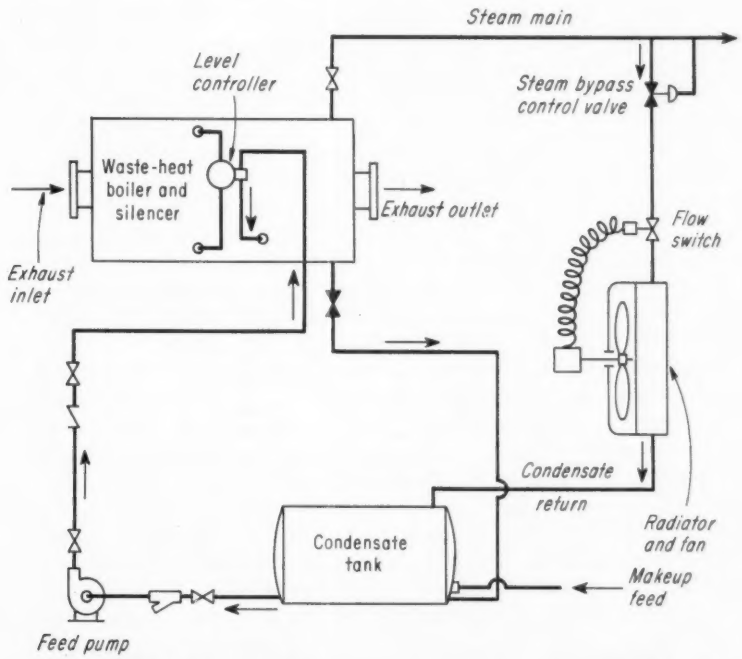
$$Q = W c_p (T_1 - T_2)$$

Where:

Q = exhaust heat recovered, Btu per hr
W = exhaust-gas flow, lb per hr
c_p = specific heat of exhaust gas, 0.25 Btu per lb
T_1 = initial exhaust-gas temperature, F



VERTICAL WASTE-HEAT BOILERS in parallel are controlled by two diaphragm valves. Decreased steam demand ups pressure, throttles flow. Result: new water level



HORIZONTAL BOILER is controlled by steam bypass. Excess steam recirculates through a radiator. It condenses and then flows to condensate tank for reuse in cycle

T_2 = final exhaust temperature, F

Exhaust flow and initial temperatures are functions of the engine design, but final temperature is determined by design of the boiler. In most cases, the heat-recovery boiler combines with the engine silencer. It may be a vertical unit or horizontal like the one shown on p 76. Extended heat-transfer surfaces increase efficiency and minimize size.

Design factors you'll want to consider carefully are dew point and water content of exhaust gas—but these aren't easy to determine. In normal installations, the sea-level dew point varies between 100 and 150 F. Your actual value is conditional upon elevation, relative humidity and water content of the fuel. Make an orsat analysis of the exhaust gas to get these accurately. Then write the reaction equation so fuel and air-fuel ratios relate to exhaust-gas analysis, and use the carbon- or hydrogen-balance method to calculate water-vapor content.

Although the quantity of heat that can be recovered depends on gas flow and initial temperature, use an approximate recovery value between 800 and 1000 Btu per bhp for preliminary studies. To determine the exact amount of heat a jacket-water system can recover, multiply jacket-water flow by temperature rise across the engine.

Either steam or hot water may be produced by heat-recovery boilers. Shells comply with Code requirements. Standard designs have wrought-iron extended heat-transfer surfaces. The silencer portion is usually fabricated steel, but where exhaust-gas corrosion is a possibility, wrought iron or special alloy steels come into the picture.

Control systems for waste-heat boilers are available in a number of different hookups. Top drawing shows a system that adapts to either a single-boiler installation or a series of boilers operating in parallel. Two diaphragm valves control operation, one in the feed line and one in the drain or dump line. Both are actuated by steam load. As demand goes up, increased steam pressure throttles the feed valve and opens the dump valve until an equilibrium point is reached where the new water level in the boiler produces enough steam to meet the demand.

Conversely, when steam demand increases and pressure drops the dump valve closes and feed valve opens to resume the higher steaming rate. A level controller guards against boiler flooding. It doubles in brass as a boiler-feed control when unit operates at design full load.

A different control-system design regulates steaming rate of the boiler by an air-operated feed-control valve with pressure pilot and a 3-way valve. If the engine is subject to wide load variations, exhaust temperature may drop below allowable minimums. But

temperature can be maintained as required by a temperature pilot which overrides the pressure pilot and throttles the feed valve to reduce boiler's steaming rate. This allows the exhaust temperature to return to the minimum or higher value.

ASME Code does not normally approve operating a boiler with a fluctuating water level, but it does permit vertical waste-heat boilers with automatic controls to vary water level and adjust steam output. The Code will *not* let you control steaming rate by varying water level of horizontal waste-heat boilers, however. System in lower drawing meets demand by diverting excess steam through a bypass control valve to a radiator or condenser. Condensate is then returned to the feed system.

Hot-water-recovery setup may combine heat from jacket water and exhaust to produce usable hot water, top drawing. The two systems operate in series, while a temperature-control valve, set to maintain the maximum engine-outlet temperature, protects the jacket-water system. Here, total heat recovered is the sum of the two systems operating in series. To figure total heat regained in terms of outlet-water temperature, first solve for heat recovered from exhaust, then cooling-water outlet temperature. The third formula sums these two in terms of boiler outlet-water temperature to give total heat recovered:

$$Q = W \times c_p\,(T_1 - T_2)$$

$$t_2 = \frac{w_2}{w_1}\,(t_4 - t_5) + t_1$$

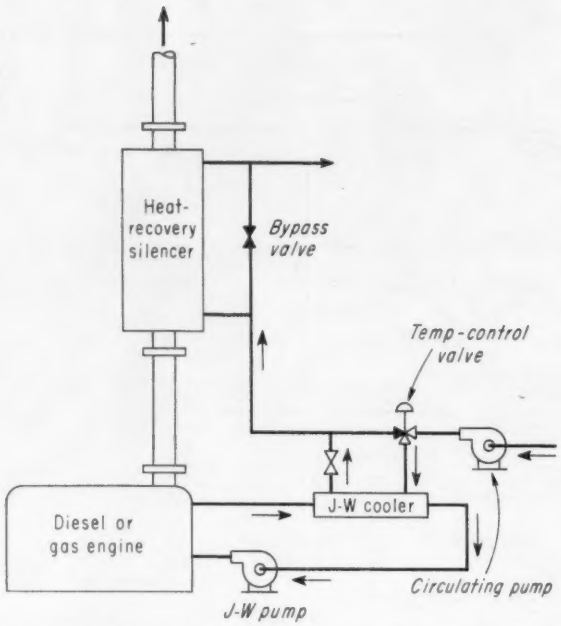
$$t_3 = \frac{Q}{w_1} + t_2$$

Where:

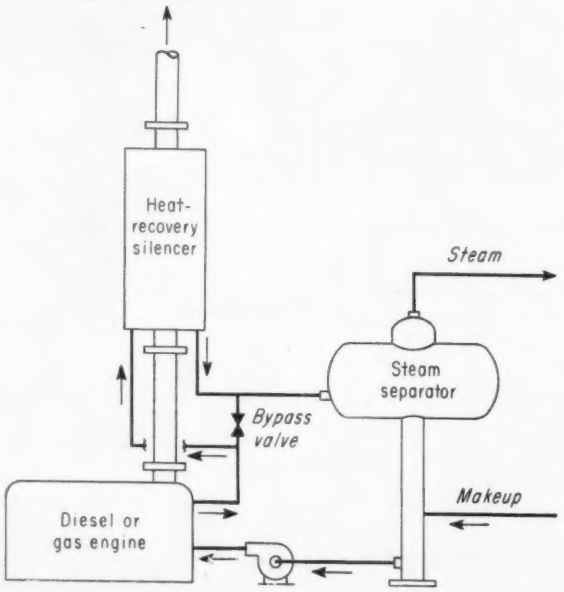
- Q = exhaust heat recovered, Btu per hr
- W = exhaust-gas flow, lb per hr
- c_p = specific heat of exhaust, 0.25 Btu per lb
- w_1 = circulating-pump flow
- w_2 = jacket-water-pump flow
- T_1 = initial (engine) exhaust-gas temperature, F
- T_2 = final (heat-recovery-boiler) exhaust-gas temperature, F
- t_1 = cooling-water inlet, F
- t_2 = cooling-water outlet, F
- t_3 = boiler-water outlet, F
- t_4 = jacket-water outlet, F
- t_5 = jacket-water inlet, F

Evaporative cooling system can be used to recover waste heat from an engine plant. Lower sketch shows the layout. It includes a steam separator to produce saturated steam with drains from the separator joining the makeup water and returning to the cooling system. Either a thermal siphon or forced circulation by a jacket pump assures adequate cooling-water flow to the diesel engine.

These are basic exhaust-heat-recovery schemes. Whatever the specifics of your individual situation, it's a safe bet that some variation can be worked out to recover maximum heat, with attendant increased thermal efficiencies.



HOT-WATER-RECOVERY SYSTEM picks up heat from both jacket water and exhaust. Control valve protects engine-jacket system



EVAPORATIVE COOLING can also be combined with a waste-heat-recovery system. Here separator's output is saturated steam

Fluid-solids handling surveyed by Hydraulic Institute

In fluid-solids systems—where large solids that won't dissolve are carried in a liquid—design problems have been solved by experience or by tests. But now the Hydraulic Institute is taking steps to formalize all available knowledge in this important hydraulic area

As materials-handling technology advances along a broad front, growing attention is focused on the area of fluid-solids handling. A fluid-solids system is essentially a pipeline through which solid matter is transported by a liquid carrier—usually water. These systems handle mainly coal, ore and cement, but of course there are many different applications within each area. In coal mining, for example, fluid-solids systems frequently transport coal through the processing plant at the mine head. But in some cases they also carry the processed coal many miles, from the mine to a point of end use such as a large steam-electric power plant.

Although fluid-solids-handling systems have been working—and working well—for many years, their design has been based largely on pilot-plant experimentation by pump manufacturers and users. Very little design information is available in the form of literature to guide a potential user through even the most preliminary stages.

Recognizing the void, the Hydraulic Institute, an association of pump manufacturers, undertook two surveys as a first attempt to formalize knowledge in this field. In addition to member pump manufacturers, many fluid-solids-system users, research groups and technical institutions were surveyed.

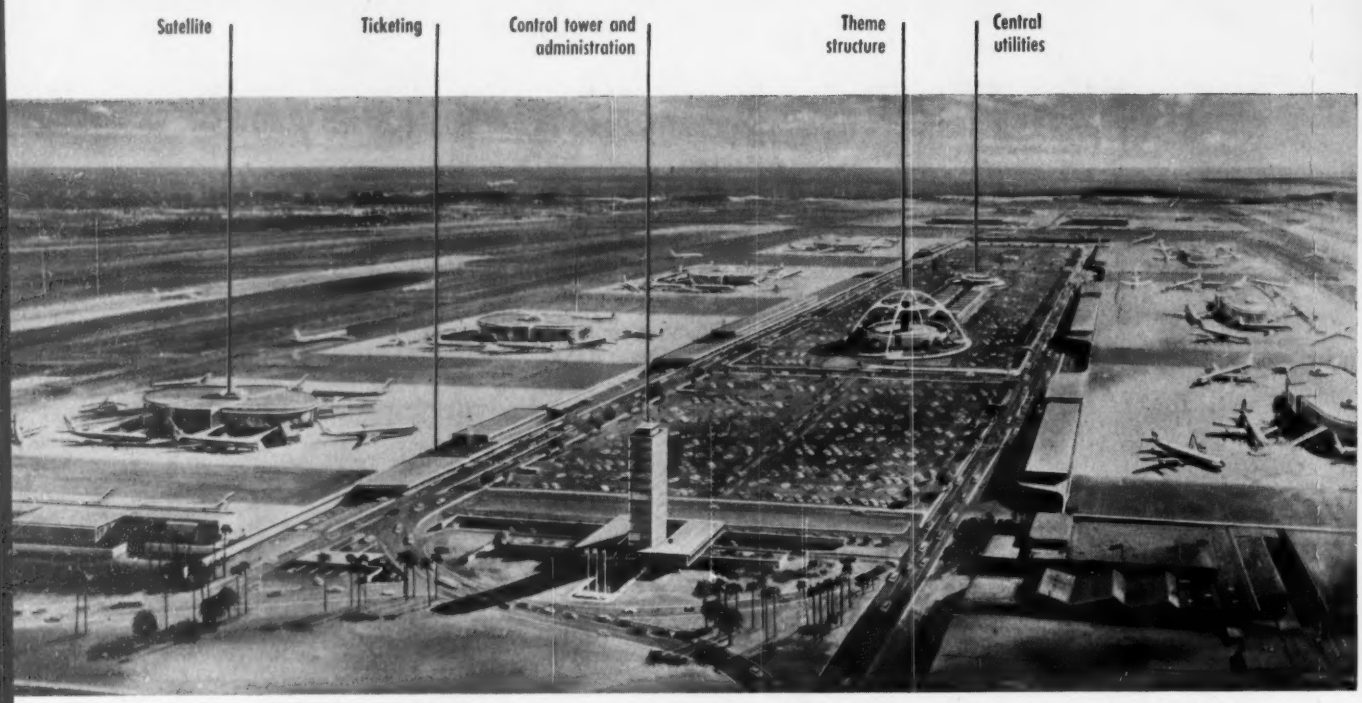
Idea was to gather together the know-how these groups had garnered over the years, through experience or through more or less formal test programs, so the questions were fairly technical and specific. A typical one: Do you think that there is more or less friction in handling a fluid-solids mixture containing 40% solids by weight than the same mixture containing 60%? In each case, groups were asked whether their replies were based on experience or opinion. As a starting point, both these surveys were qualitative; they aimed not only to dig out specific information where it exists but to find areas where opinion diverges widely or knowledge is almost totally lacking.

A careful review of survey replies reveals that a considerable body of basic data *does* exist—a foundation for further investigation and study. For the most part, this firm data falls in the area of velocities and friction drops.

Velocity needed to successfully carry solids depends mainly on a screen analysis of the solids. But this so-called minimum carrying velocity is influenced by many additional factors, such as: (1) Relationship between densities of the fluid-solids mixture and percent of solids by weight. (2) Specific gravity of the solids as it relates to specific gravity of the transporting liquid. (3) Pipe configuration plays a part; sloping line probably requires a higher minimum velocity than either a strictly horizontal or a vertical line. (4) Larger pipe diameters need higher velocities. If three identical fluid-solids mixtures are handled at varying volumes, a higher velocity is required for an 8-in. pipe than a 2-in. one would need. And a 14-in. pipe would take a higher velocity yet. (5) Slimes or colloidal material radically affect minimum carrying velocity for any fluid-solids mixture.

Friction in a pipeline carrying a fluid-solids mixture also seems to be subject to a number of influences, such as: (1) Screen analysis of the included solids. (2) Density, percent of solids by weight or in some cases both factors. (3) Fluid-solids mixtures containing solids with different specific gravities—coal and silica or sand, iron concentrates—have widely varying friction losses. (4) In a mixture having equal percentage of solids by volume, the higher the specific gravity of the solids, the higher will be the friction loss in the pipeline. (5) Up to about 30 to 40% solids by weight (assuming an adequate carrying velocity), losses about equal friction losses of water in a similar clean pipe. But above these concentrations, losses may go higher. (6) Slimes of colloidal material affect friction loss in any fluid-solids mixture. (7) Interior pipe surface will definitely influence friction loss when fluid-solids flow velocity comes in the turbulent range. (8) If a large pipe is partially filled with solid material so its flow area is effectively reduced to that of a smaller clean pipe, friction losses in these two pipes will not be equal even at the same flow velocity.

Interest in this area of hydraulic technology is growing as more and more design engineers consider use of fluid-solids-handling systems. It is therefore to be hoped that the industry will not be satisfied with these qualitative surveys, but will move forward to organize and formalize the results, giving designers the detailed quantitative information they need for preliminary work. POWER is following this activity closely; as fresh information comes along, we'll report it to our readers.



LOS ANGELES INTERNATIONAL AIRPORT covers 265 acres. Architect's rendition emphasizes magnitude of air-conditioning problem faced by designers. Central utilities building supplies all terminal structures with HTHW for heating and chilled water

Central system at new airport tackles complex air-conditioning job

Control center monitors overall system operation, allocates cost of heating and cooling by metering Btu load of each airline facility

The new Los Angeles International airport terminal is equipped with an outstanding air-conditioning system. Faced with a sprawling complex of terminal buildings, designers engineered a central system for maximum efficiency, minimum operating and maintenance cost.

Central utilities plant is actually the airport's comfort center. Chilled water is generated for cooling and high-temperature hot water for heating. Designers believe their HTHW system to be sixth largest in the world.

Room air temperatures, water temperatures and water flow rates are all automatically controlled. A supervisory control system monitors operation of all major equipment. Large graphic panels display temperature, pressure and operating data for pumps, valves, air-handling units and other equipment. With an eye on the future, provision has been made to expand refrigeration system and boiler plant.

Refrigeration machines are located in south half of circular utility building. A total 3400-tons capacity is available to chill water for cooling. The two 1500-ton centrifugal compressors are driven by synchronous motors, a 400-ton absorption unit operated by HTHW. There's space for future addition of one 2000-ton centrifugal compressor to cope with an estimated ultimate 5400 tons.

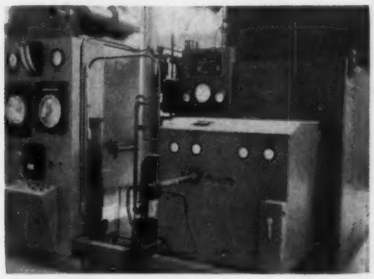
Water is chilled to 40 F and pumped through insulated piping to terminal buildings for air conditioning. It returns to the plant at 52 F for rechilling. Refrigerant heat is liberated to atmosphere through cooling towers located on grade west of the utilities building. These towers are forced-draft design with redwood fill. The 3-way modulating valves also divert cooling water to absorption-unit condensers. Space is allotted for a future third cooling-tower cell.

Boiler plant supplies HTHW at 350 F, 230 psi. Three 22-million-Btu-per-hr boilers, located in north half of the utilities building, are fired with natural gas, fuel-oil standby. A fourth boiler can be added in time to come.

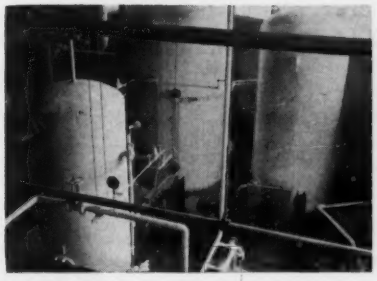
HTHW is pumped to 35 heat exchangers at terminal buildings. These units heat cold water to 200 F for space heating or to 140 F for general use. High-temperature water returns to boilers at about 250 F. Return line from each building dumps into a common 12-in. return header at the

Utility building houses refrigeration machines, HTHW boilers

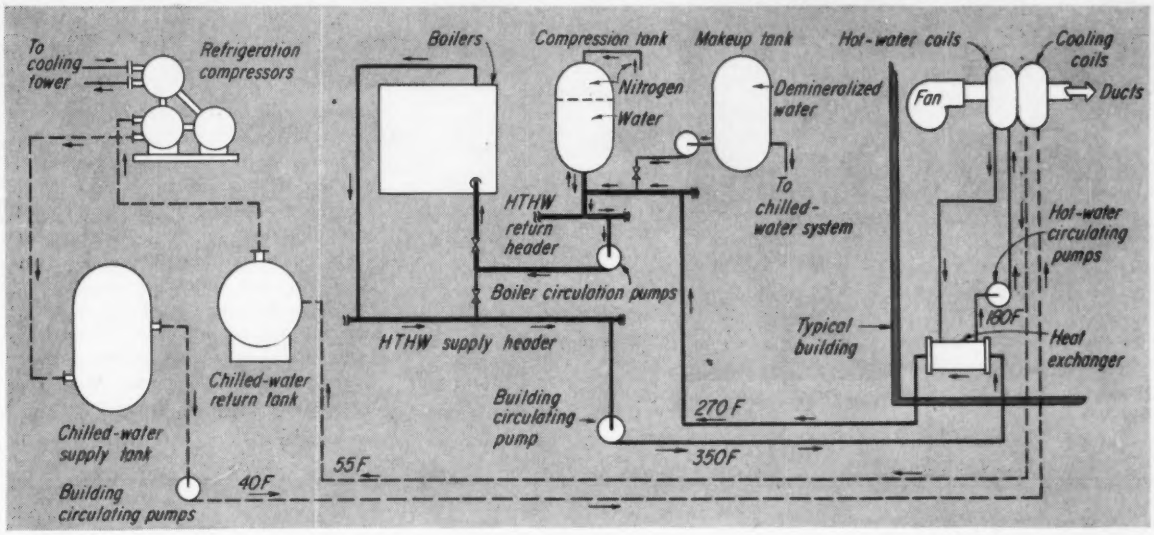
REFRIGERATION area produces 3400 tons



BOILER capacity: 22-million Btu per hr ea



COMPRESSION TANKS adjoin storage



CENTRAL UTILITY SYSTEM chills water to 40 F with either of two 1500-ton centrifugal compressors or a 400-ton absorption unit. H-t water at 350 F, 230 psig is supplied by three boilers. There's space to add one more boiler and a 2000-ton centrifugal unit

central plant and this feeds the boiler circulating pumps. Water circulates through boilers and enters the HTHW supply header. At this point supply pumps for each building recirculate HTHW back to each heat exchanger.

Nitrogen keeps the closed HTHW system pressurized around 300 psi to raise boiling point of water beyond 400 F. This job is handled by a pair of compression tanks (one a spare) about two-thirds filled with water and one-third with nitrogen. HTHW does not circulate through tanks—they just float on line.

Water quality is extremely important even though the closed system keeps water losses small, because at these elevated temperatures, corrosion and scaling could occur at a rapid pace. Scale is avoided by initially filling the system with demineralized water; small amounts of chemical are then added to adjust pH and prevent corrosion. System makeup is also taken from the demineralized-water storage tank, which doubles as a surge tank by handling water overflow from HTHW system caused by expansion at startup.

Total connected power load at central plant is 5800 kva. It can expand to 12,500 kva. All power is distributed at 34.5 kv and supplied at 430/277-Y for general use; central-plant synchronous motors get a 5-kv supply.

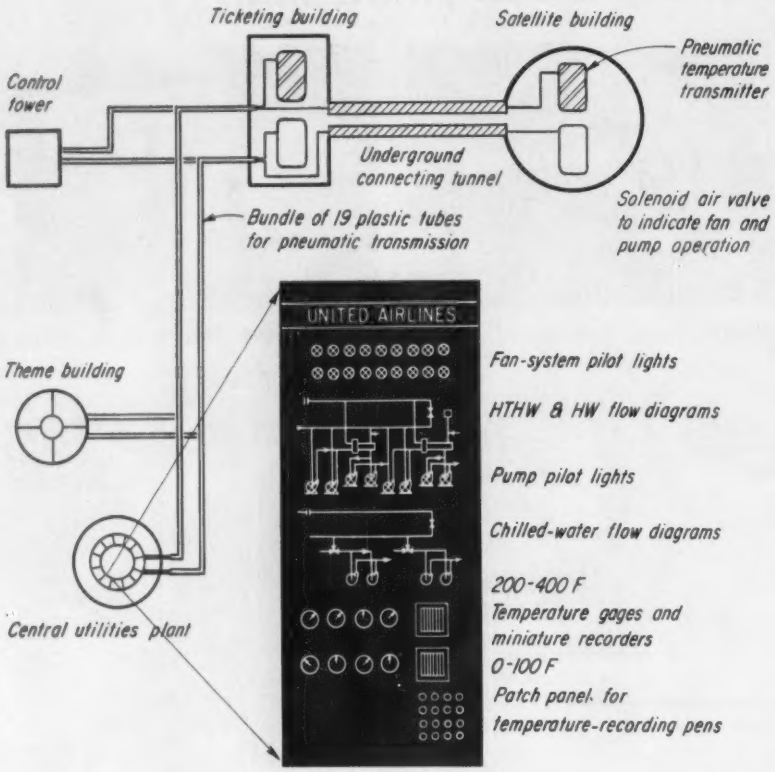
Chilled water and HTHW are distributed underground through a system of insulated welded-steel pipes. Separate circuits for chilled water and hot water serve each group of buildings. About 20 miles of underground pipe, 4-, 6-, and 8-in. diameter, circulate 10,000 gpm of chilled water and 2000 gpm of HTHW. This calls for a total centrifugal-pump capacity of more than 500 hp.

Packaged units to handle air at terminal buildings are fed with chilled water and 200-F hot water. Filtered air blows across either of two coil systems, one containing 200-F water and the other chilled water. This conditioned air then passes through ducts to occupied spaces.

Control system is basically pneumatic. Central graphic panel shows function, operation and temperature in each system. About 75 miles of small copper tubing connect the various control devices, transmitting data back to the graphic panel over distances as great as one mile.

continued

Pneumatic transmission lines relay control signals to panel



TYPICAL CONTROL PANEL

Typical control panel for one building, left, includes a raised schematic diagram of the chilled-water and HTHW systems. Pilot lights for pumps and fans indicate system operation.

Pneumatic temperature transmitters in ticketing and satellite buildings relay temperature of hot and chilled water to control panel. Air output, somewhere in the range of 3 to 15 psi, is proportional to temperature being sensed. Resulting control signals are transmitted through bundles containing up to 19 plastic air tubes; two bundles serve each building and run underground to the control panel in the central utilities building. On the panel, a gage converts air signal into direct temperature reading.

Same bundles also transmit air signals to indicate fan and pump operation. A solenoid valve opens when a fan or pump starts, sending 15-psi air to pressure-electric switches on the panel. This closes electric contacts and operates pilot light for that equipment.

Each panel has fan-system pilot lights for 18 different systems in the building. One heat exchanger is for the ticketing building and the other for its satellite. Individual pilot lights indicate operation of four HTHW pumps, four low-temperature hot-water pumps.

Flow of hot and chilled water is metered and controlled. Differential-pressure controller in the return line automatically adjusts a pilot-operated flow-control valve in the bypass between supply and return lines to maintain a constant flow rate.

Each airline is charged for air conditioning — heating or cooling — by the number of Btu's its buildings use. Btu instrument on the back of each airline's control panel, above, records flow of both chilled water and HTHW. Temperature difference between supply and return lines is also measured and recorded. Flow and temperature-difference signals are continuously multiplied to give Btu's expended or consumed at each location. The instrument has three recording pens.

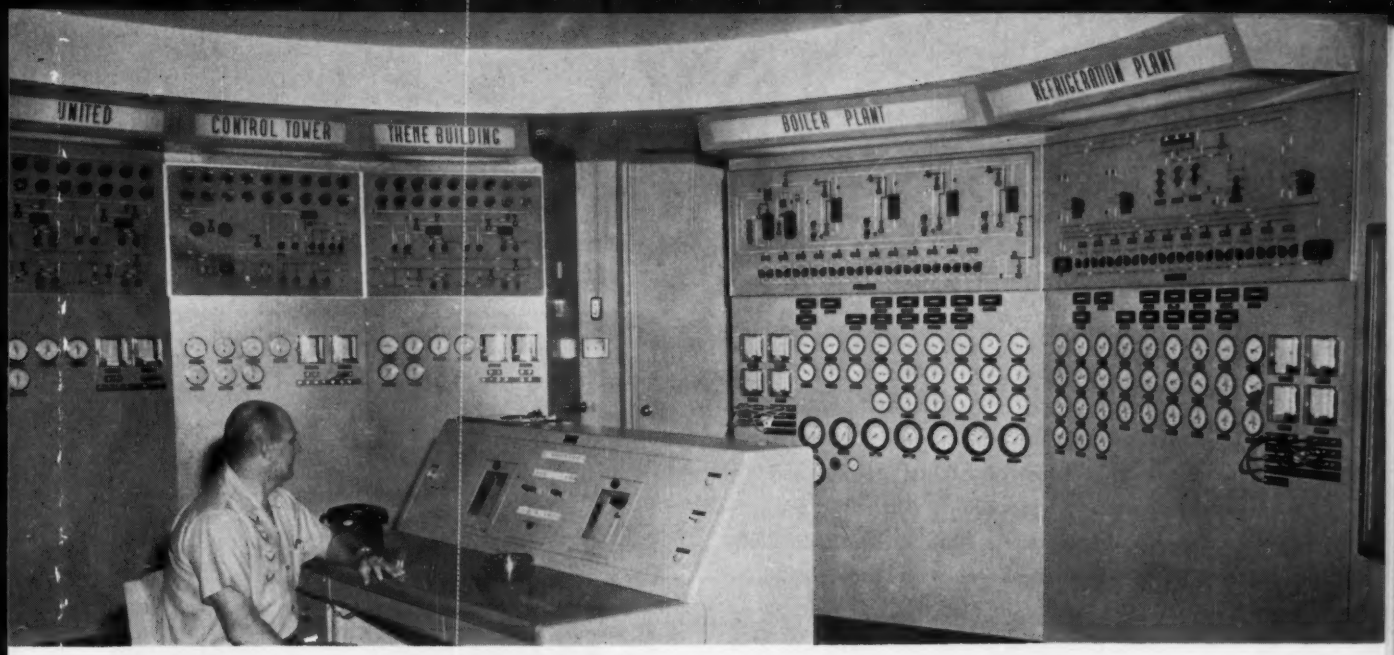
Total of 26 Btu meters are employed. Each boiler and refrigeration machine has one instrument—six in all. Each building group has one on chilled water and another on hot water to account for 18 more. Remaining two meters handle hot and cold water for the utilities building.

Temperature-control systems vary with location. Air-handling units serving single zones employ a pilot-operated 3-way valve on lines feeding the heating and cooling coils. These valves are controlled in sequence by thermostats located in the area served. When room temperature increases above thermostat setting, control valve on hot-water coil modulates to a bypass position. Further rise opens valve on chilled-water coil. When temperature drops below set-point, the action reverses.

Multizone units use a thermostat with bulb located in the hot plenum. This adjusts pilot-operated 3-way valve to the hot-water coil to keep desired hot plenum temperature. Master thermostat with bulb in outside air resets plenum thermostat in accordance with a predetermined schedule. An electric-solenoid air valve energizes the control system when supply fan is in operation; when fan is shut down it cuts out the system and returns all controls to normal position.

Solenoid valves also operate fan-indication lights on the graphic panels. Room thermostats in each zone operate hot and cold mixing dampers, which mix air to maintain desired zone temperatures.

Constant-volume mixing-box control is used in areas served by double-duct system. When room thermostat calls for heat, the hot valve in the mixing box opens to increase flow of hot air. This increases total air flow from the box. Change in outlet flow is sensed by a micropressure regulator which repositions the cold-air valve to reduce air flow. This system maintains constant flow from the mixing box regardless of thermostat demand or duct-pressure variation. In effect, each zone mixing box is controlled by



Central control room: heart of a-c system

Central control room in the utilities building's circular core has ten panels for hot- and cold-water systems serving airport buildings. First panel is for future use. Panels 2 to 7 monitor ticketing and satellite buildings occupied by airlines. Panel 8 handles a satellite building only. No. 9 is for the control tower and 10 the Theme building. Separate panels handle central boiler and refrigeration plant.

Desk above houses a special supervisory control system to record and sound an alarm for 19 different malfunctions or abnormalities. Two rectangular panels on sloping part of desk contain condition wheels—one wheel on standby—to record exact location and time of trouble. Critical items like (1) fire (2) water flow through sprinkler system and (3) cold-water flow through entire system are recorded five times in sequence and a sixth time when fault is corrected. Control system has three locks—one for each operator on three shifts. When malfunction is recorded operator must immediately acknowledge it by inserting and turning his key in the lock. If he doesn't do this within three minutes, it's noted and another alarm sounded.

a room thermostat that in turn controls the hot valve of the mixing box to keep room temperature at desired level. Micropressure regulator maintains flow of incoming conditioned air and constant static room pressure.

Supervisory control system installed in operator's control console in the central control room, above, monitors the complete air-conditioning system plus a host of other critical plant functions. This system operates on the regular alternating-current supply, but in case of a break in service the unit automatically switches to the airport's emergency-generator setup.

If malfunction occurs at the control desk but current is still available for the control circuits, a memory system stores all reports of trouble. When the control desk goes into operation again all these delayed malfunction reports are then recorded.

Labeled lights on the control desk announce many critical troubles at a glance; troubles are also recorded, of course. Engineer on duty checks these lights as well as recorded information on the condition wheel.

These are the 19 items recorded: (1) *fire*—all fire alarms are monitored (2) *patrol*—all security patrols are checked in (3) *water flow* through sprinkler heads (4) *start* and (5) *stop* of all motors (6) *abnormal* and (7) *normal* data on transformer temperatures, gas pressure in underground cable, boiler and compressor operation, etc (8) *cold-water* flow to spot trouble in chilled-water systems (9) *valve closed* and (10) *valve open* for all critical valves (11) *gate open* and (12) *gate closed* at critical or hazardous areas (13) *gas operating* and (14) *oil operating* to monitor boiler fuel in use (15) *tie breaker open* and (16) *tie breaker closed* (each area has two bus systems and malfunction of one automatically cuts in the other) (17) *operator* must use his key to indicate he's on duty (18) *delinquent* — if operator does not answer alarm within three minutes he is recorded delinquent (19) *Autocall* monitors any malfunction of supervisory system.

Principal plant equipment includes: (1) Boilers by Combustion Engineering Co. (2) Refrigeration machines by York Corp div of Borg-Warner Corp. (3) Cooling towers by Marley Co. (4) Pumps by Byron-Jackson Pumps, Inc. (5) Air-handling units by Drayer-Hanson, div of Crane Corp, McQuay, Inc and Recold Corp. (6) Exhaust fans by Aladdin Heating Corp, Penn Ventilator Co and New York Blower Co.

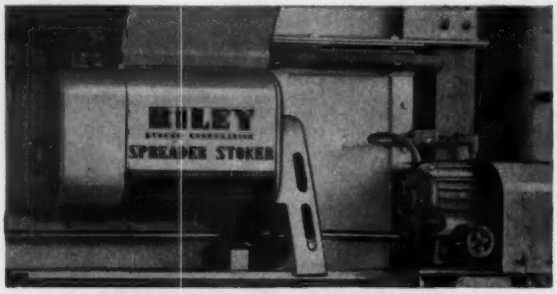
Temperature controls and graphic panels are furnished by Johnson Service Co. Supervisory system is by Autocall Corp. Architects include Charles Luckmann Assoc, Welton Becket & Assoc and Paul R Williams. Consultant: J S Hamel Engineer.

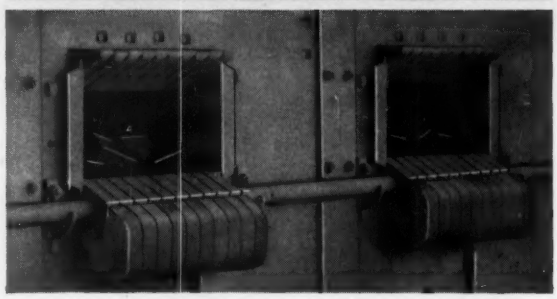
For Fuel Firing Versatility ...Low Cost Maintenance ...High Operating Efficiency

INSTALL

Riley Traveling Grate Spreader Stokers efficiently burn coals having a wide range of coking, caking, and ash fusion characteristics. High working efficiencies are produced with low grade fuels such a sub-bituminous coals, lignite, wood refuse, bagasse, and other cellulose materials.

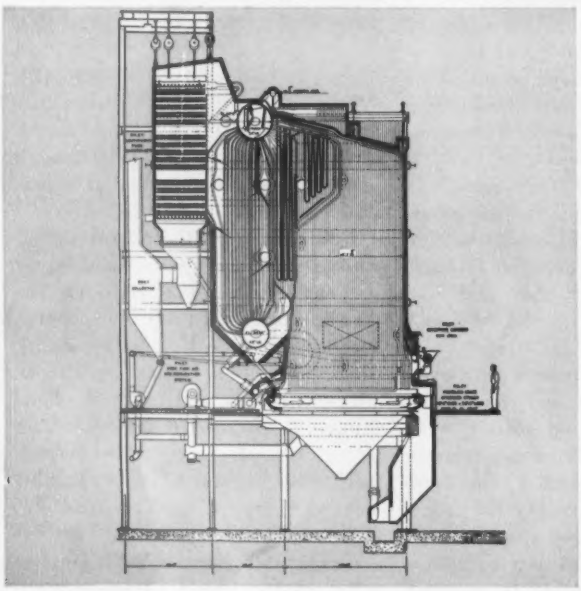
B. F. Goodrich, Champion Paper and Fibre Co., E. I. Dupont de Nemours, General Electric, Montana-Dakota Utilities, Gaylord Container, Utah-Idaho Sugar, Kennecott Copper, Swift & Co., Bendix Aviation, Armstrong Cork are but a few of many prominent companies that are using Riley Spreader Stokers under Riley Boilers. Such performance-proven installations as these substantiate the superior operating characteristics of Riley Spreader Stokers: uniformity of feed and distribution . . . complete, continuous combustion . . . low carbon loss . . . high day-to-day overall efficiency . . . long-term, low-cost maintenance.





Two Feeder Models

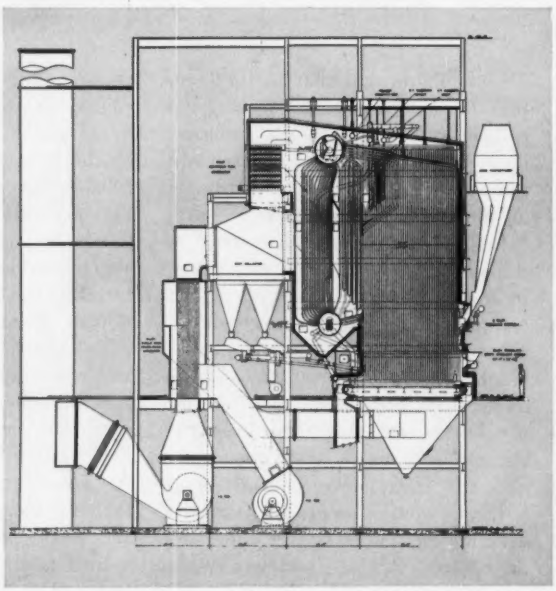
Riley Spreader Stoker Model 'B' Feeders are supplied for capacities up to 200,000 lbs/hr; Model 'D' Feeders for boiler capacities over 200,000 lbs/hr have feeder drum in coal hopper which meters coal regardless of moisture. Adjustable distributor blades give uniform coal distribution.



In Combination With Natural Gas Firing

Deere & Company, Moline, Ill.

Two 16' x 19' Riley Traveling Grate Stokers equipped with Riley Model "D" Feeders fire two complete Riley Steam Generating Units with pressurized furnaces. Riley Intertube Gas Burners fire natural gas as an auxiliary fuel. Capacity 135,000 lbs/hr, 750F, 650 psig. Efficiency 84.8%.



Simultaneous Bark and Coal Firing

Marathon Southern Corp., Naheola, Alabama

A 26' x 22' Riley Traveling Grate Spreader Stoker, fed by Riley Model 'D' heavy-duty Coal Feeders and Riley Pneumatic Bark Distributors, fires this 300,000 lb/hr Riley Steam Generating Unit with an efficiency of 85%. 975 psig, 825F.

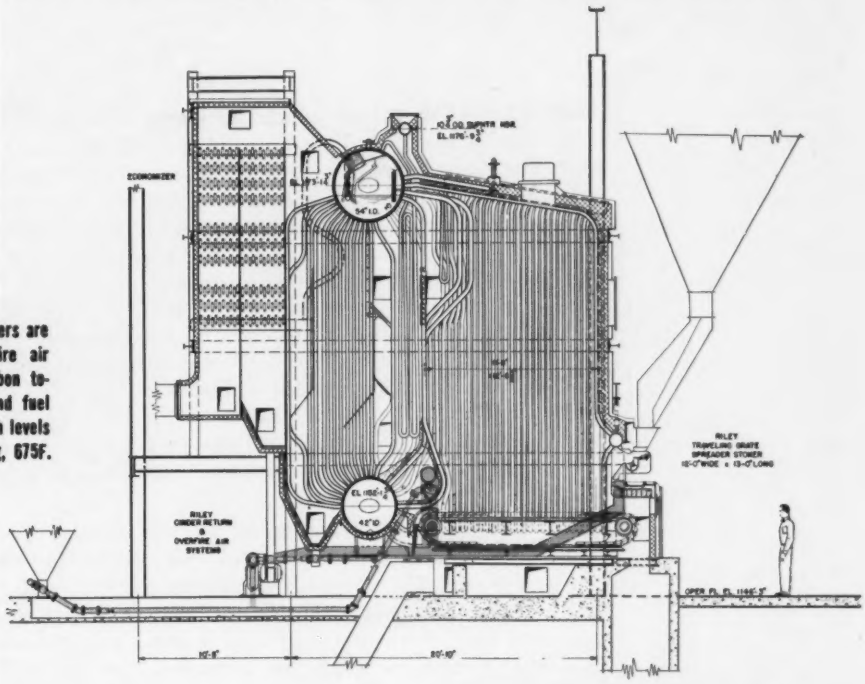
RILEY SPREADER STOKERS

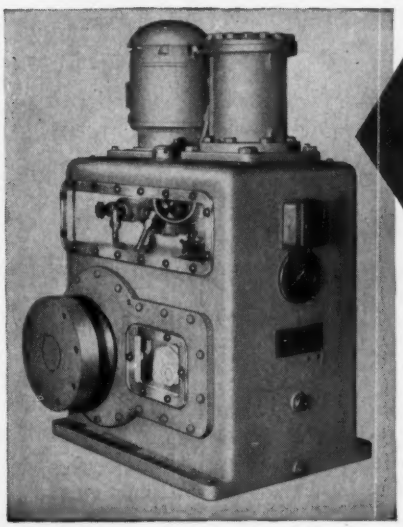
With Either Traveling, Oscillating, Dumping or Stationary Grates

Cinder Return And Overfire Air System

Pennsylvania Railroad, Juniata Shops, Altoona, Pa.

Many Riley Traveling Grate Spreader Stokers are equipped with cinder return and overfire air systems. High recovery of unburned carbon together with intimate blending of air and fuel assures a wide range of operation at high levels of efficiency, 3 — 60,000 lb/hr, 600 psig, 675F.





Smooth, Continuous Operating Hydraulic Drive for Traveling Grates

The self-lubricated Riley Hydraulic Traveling Grate Drive power unit operates quietly and smoothly with uninterrupted continuous automatic or manual speed control from stop to full load. The design does away with sprockets, chains or gears. A pressure gauge describes load conditions at all times.

High Efficiency Grate Surface

Providing high efficiency with low maintenance requirements, the surface of the Riley Traveling Grate Spreader Stoker has small (2" x 6") overlapping grate clips, of special heat-resisting alloy. Nose-over-tail design forces clips to separate when starting return travel, freeing themselves of ashes and clinkers. Tuyeres in the center and at sides of clips give uniform air distribution.

A careful survey of your plant by a qualified consulting engineer could show ways of making substantial savings in power costs.

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Call any of the sales offices below for technical advice covering your requirements for both boiler and fuel burning equipment.

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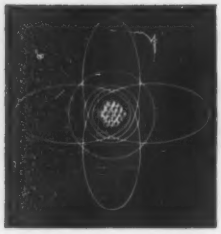


Nuclear notes

By B G A SKROTZKI, Associate Editor

Some 14,904,259 gal of radioactive waste were handled by Dresden Nuclear Power Station between April 1960 and Aug 1 of this year. Some of the waste-filled liquid was demineralized and reused, the rest dumped into the Illinois River—but at a carefully controlled rate seldom exceeding 10 micro-microcuries of unidentified radioactivity per liter. As W Kiedaisch of Chicago's Commonwealth Edison Co, operator of Dresden Station, told the AIChE, state regulations limit discharge of radioactive waste to below 100 micro-microcuries per liter. In general, Dresden keeps its addition to the river water to one-tenth the allowable rate; it's rare that they add as much as 50 micro-microcuries during discharge of any batch. If radioactivity is too high, plant's waste concentrator reduces the volume of wastes and they're stored. Later, river water is added to dilute the wastes to a satisfactory concentration. During operation, disposal costs about 5¢ for 1000 gal. But when the plant isn't running, operation of the two 80,000-gpm circulating pumps must be charged entirely to waste disposal; then the discharge rate jumps to $35 per 1000 gal.

Joint U.S.—Euratom program invites second-round proposals for large-scale nuclear-power plants to start up before 1966. These bids are invited in line with the 1958 Agreement for Cooperation between the U.S. and Euratom—the European Atomic Energy Community, composed of Belgium, West Germany, France, Italy, Luxembourg and the Netherlands—to develop peaceful uses of atomic energy. Private or governmental organizations within the Community can bid by June 1, 1962. Reactors are to be types already well developed in the U.S.; an acceptable project must be built and running by Dec 31, 1965, and capable of operation for ten years after that as a source of safe and reliable power. Meanwhile, a definitive contract has been awarded for a 242-mw underground French-Belgian plant with closed-cycle water reactor of Westinghouse design. Contract went to Westinghouse Electric International of the U.S., Belgium's Ateliers de Constructions Electriques de Charleroi and Framatome of France. Last year Euratom allocated $8 million toward the project at Chooz, France.

Second Antarctic nuclear power plant will be subject of contract negotiations between AEC and Alco Products Inc of Schenectady, N. Y. The PL-3 (Portable Low-Power Reactor No. 3) will provide electric power and steam for Byrd Station, 700 miles from the South Pole, plus steam to melt snow for fresh water. Invitation to bid, issued in May, called for a plant capability of 1 mw of electricity and 1.5-million Btu per hr of steam (see *Nuclear Notes*, July 1961, p 84).

Atomic generating stations can compete economically in the New England and Pacific regions of the U.S., says Westinghouse v-p Charles H Weaver. The Middle Atlantic is on the verge of becoming a candidate. But, he stresses, nuclear power isn't yet an off-the-shelf item; each utility must consider a nuclear plant in light of its own situation.

AEC proposed shipment procedures for spent fuel elements aim to safeguard against accidental criticality, radiation exposure and release of fission products en route. These specs apply to solid irradiated fuel elements topping 2000 curies of radioactivity in a single container. Each licensee will need AEC approval of his cask design and shipping procedures.

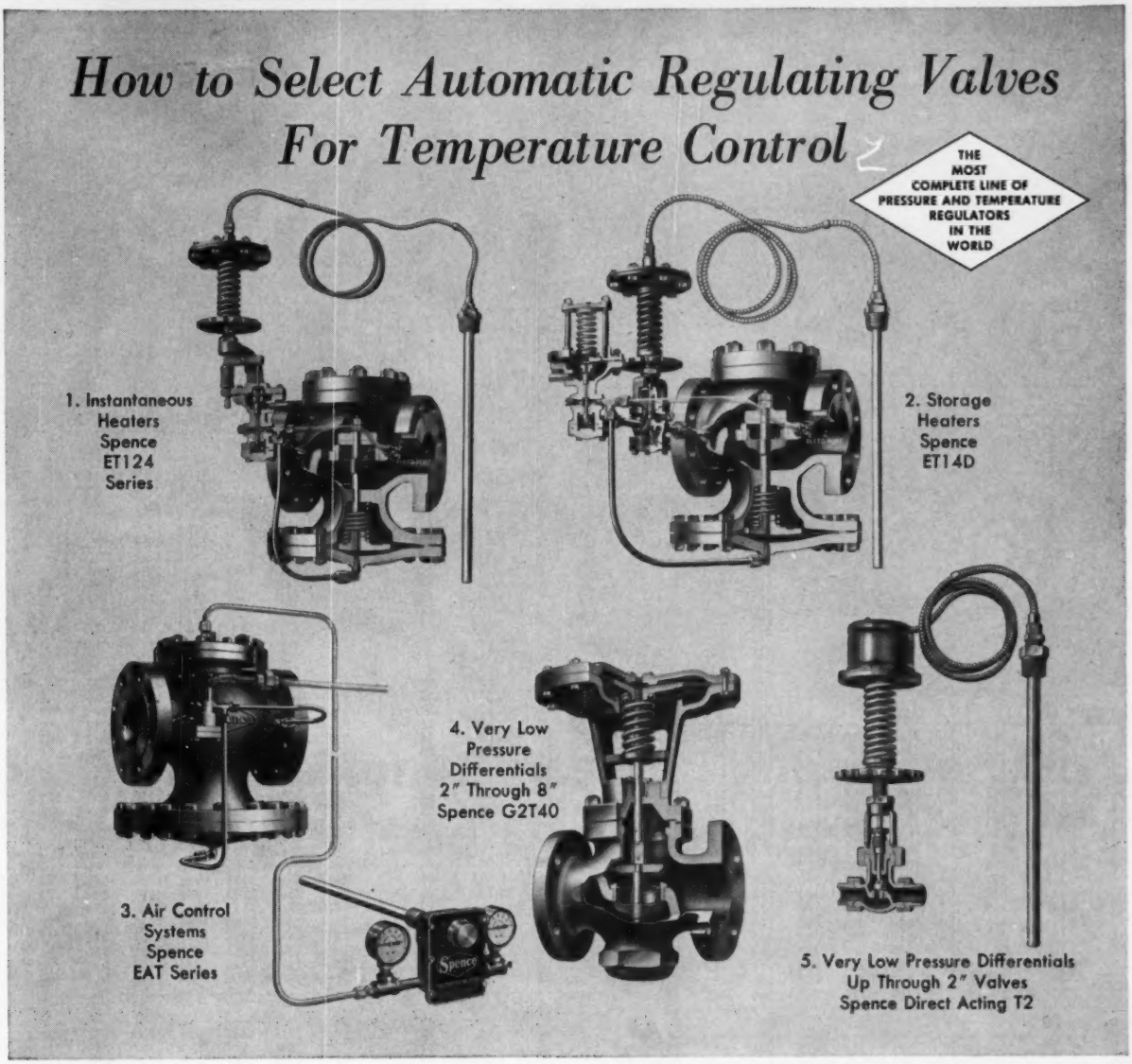
Radiation readings in the SL-1 at National Reactor Testing Station in Idaho have dropped to 15 roentgens per hr immediately above the reactor head, 10 roentgens per hr on the operating floor. That's a 90% reduction since major decontamination work started in June, following last January's accident (see *Nuclear Notes*, Aug 1961, p 68).

(Advertisement)

VALVE TIPS:

How to Select Automatic Regulating Valves For Temperature Control

THE MOST COMPLETE LINE OF PRESSURE AND TEMPERATURE REGULATORS IN THE WORLD


1. Instantaneous Heaters Spence ET124 Series
2. Storage Heaters Spence ET14D
3. Air Control Systems Spence EAT Series
4. Very Low Pressure Differentials 2" Through 8" Spence G2T40
5. Very Low Pressure Differentials Up Through 2" Valves Spence Direct Acting T2

During the past year, our field representatives have reported many cases of improperly, and uneconomically, applied temperature regulators. To help you avoid some of these costly mistakes, here are a few tips on selecting the most effective and economical temperature regulating valves for your applications.

1. Instantaneous heaters require a special action for close temperature control and freedom from hunting. In the Spence ET124 series, steam pressure is modulated according to temperature (demand) and is automatically regulated at any pressure established by the demand.
2. Storage heaters, on the other hand, are more economically controlled by the Spence ET14D, which includes a simple temperature-actuated pilot that opens and closes the main valve to maintain a constant temperature.
3. Air control systems can now have a ±5°F control accuracy under wide and instantaneous load swings with the Spence EAT regulator. Engineers report savings of up to 50% in installed costs with this recently developed Spence cascade system when it has been used in place of conventional instrumentation.
4. For the combination of very low pressure differentials and air or water control, Spence recommends Type G2T40. This single seated pilot operated valve provides fast, positive response in 2" through 8" valves. Double seat Type G22 is also available in 10" through 12".
5. When very low pressure differential is encountered with valves of 2" or less, the Spence direct operated T2 is recommended. The sensitive vapor tension thermostat responds quickly to small changes in bulb temperature for continuous, accurate control.

In this brief description of industrial process and heating temperature control, we have given a few important tips in proper regulator selection. If you would like more detailed information on these control applications, write for the new Spence Temperature Control Bulletin IV 1014. 88-180

SPENCE ENGINEERING COMPANY, INC.
Walden 1, N. Y.
Paulsen Spence, P. E., President

Power's data sheet

No. 351

Alloy-steel pipe to ASTM Spec A-335 Grade P-22 (2¼% Cr—1% moly)

Pipe size, in.	Nom OD, in.	Wall thick, in.	Temperature, F: To 800	850	900	950	1000	1050	1100
			Maximum allowable stress, psi: 15,000	14,400	13,100	11,000	7800	5800	4200
Schedule 10									
14	14	.250	475	456	415	350	249	186	134
16	16	.250	415	399	363	305	218	162	117
18	18	.250	369	354	322	271	193	144	104
20	20	.250	331	318	289	244	173	129	93
24	24	.250	276	265	241	203	144	107	78
Schedule 20									
8	8.625	.250	777	746	679	573	411	305	221
10	10.75	.250	621	596	543	458	327	243	176
12	12.75	.250	522	502	456	384	275	204	148
14	14	.312	594	571	519	438	310	233	168
16	16	.312	519	498	453	382	273	203	147
18	18	.312	461	442	402	339	242	180	130
20	20	.375	499	479	435	367	262	195	141
24	24	.375	415	398	362	305	217	162	117
Schedule 30									
8	8.625	.277	861	827	752	635	456	339	245
10	10.75	.307	766	735	669	565	405	301	218
12	12.75	.330	693	665	605	510	365	272	197
14	14	.375	716	688	626	528	378	281	203
16	16	.375	625	600	546	460	329	245	177
18	18	.438	649	623	567	478	342	254	184
20	20	.500	669	642	584	493	352	262	190
24	24	.562	625	600	546	460	329	245	177
Schedule 40									
⅛	.84	.109	1103	1059	963	815	586	436	316
¼	1.05	.113	997	957	871	736	529	393	285
⅜	1.315	.133	1200	1152	1048	887	639	475	344
½	1.66	.14	1078	1035	942	797	573	426	309
¾	1.90	.145	1005	965	878	742	533	397	287
1	2.375	.154	905	869	791	668	479	356	258
1¼	2.875	.203	1217	1168	1063	900	649	482	349
1½	3.50	.216	1094	1050	955	808	582	432	313
2	4.50	.237	1433	1375	1251	1061	767	570	413
2½	5.563	.258	1259	1209	1100	931	672	500	362
3	6.625	.28	1143	1097	998	845	608	452	328
3½	8.625	.322	1007	967	880	744	534	397	283
4	10.75	.365	912	875	796	673	483	359	260
5	12.75	.406	854	820	746	630	452	336	243
6	14	.438	839	806	733	619	444	330	239
8	16	.50	840	806	733	619	444	330	239
10	18	.562	838	805	732	618	443	330	239
12	20	.593	797	765	696	587	421	313	227
14	24	.687	768	737	671	566	406	302	218
Schedule 60									
8	8.625	.406	1277	1226	1115	944	681	507	367
10	10.75	.50	1263	1213	1103	934	674	501	363
12	12.75	.562	1195	1147	1043	883	636	473	343
14	14	.593	1148	1102	1003	849	611	454	329
16	16	.656	1108	1064	968	819	589	438	317
18	18	.750	1126	1081	983	832	599	445	323
20	20	.812	1098	1054	959	811	584	434	314
24	24	.968	1091	1047	953	806	580	431	312
Schedule 80									
⅛	.84	.147	2434	2337	2126	1814	1330	989	716
¼	1.05	.154	2113	2028	1845	1571	1147	853	618
⅜	1.315	.179	2222	2123	1940	1654	1209	899	651
½	1.66	.191	1939	1861	1693	1440	1049	780	565
¾	1.90	.20	1821	1748	1591	1352	983	731	529
1	2.375	.218	1661	1595	1451	1232	894	664	481
1¼	2.875	.276	1942	1864	1696	1443	1051	781	566
1½	3.50	.30	1778	1707	1553	1319	958	713	516
2	4.50	.337	2076	1993	1813	1543	1126	837	606
2½	5.563	.375	1857	1782	1621	1379	1003	746	540
3	6.625	.432	1793	1721	1566	1331	967	719	521
3½	8.625	.50	1588	1524	1387	1177	853	634	459
4	10.75	.593	1510	1449	1318	1118	809	602	436
5	12.75	.687	1472	1413	1286	1090	789	586	425
6	14	.75	1460	1402	1275	1082	782	582	421
8	16	.843	1439	1381	1257	1065	770	573	415
10	18	.937	1420	1363	1240	1051	760	565	409
12	20	1.031	1404	1348	1226	1039	751	558	404
14	24	1.218	1383	1328	1208	1024	740	550	398

Pipe size, in.	Nom OD, in.	Wall thick, in.	Temperature, F: To 800	850	900	950	1000	1050	1100
			Maximum allowable stress, psi: 15,000	14,400	13,100	11,000	7800	5800	4200
Schedule 100									
8	8.625	.593	1900	1824	1659	1411	1027	764	553
10	10.75	.718	1842	1768	1608	1367	994	739	535
12	12.75	.843	1823	1750	1592	1354	984	732	530
14	14	.937	1846	1772	1612	1371	997	741	537
16	16	1.031	1771	1700	1547	1314	955	710	514
18	18	1.156	1766	1696	1542	1311	952	708	513
20	20	1.281	1760	1690	1537	1306	949	706	511
24	24	1.531	1753	1683	1531	1301	945	703	509
XX									
⅛	.84	.294	8389	8054	7327	6517	5242	3898	2823
¼	1.05	.308	6941	6664	6062	5337	4191	3117	2257
⅜	1.315	.358	6658	6391	5814	5109	3994	2970	2151
½	1.66	.382	5585	5361	4877	4254	3269	2431	1760
¾	1.90	.400	5114	4910	4466	3883	2962	2203	1595
1	2.375	.436	4480	4301	3913	3387	2559	1903	1378
1¼	2.875	.552	4934	4737	4309	3741	2847	2117	1533
1½	3.50	.600	4407	4230	3848	3329	2513	1869	1353
2	4.50	.674	4394	4218	3837	3319	2505	1863	1349
2½	5.563	.750	3905	3749	3411	2940	2203	1638	1186
3	6.625	.864	3767	3616	3290	2834	2118	1575	1141
3½	8.625	.875	2868	2753	2504	2144	1582	1176	852
Schedule 120									
4	4.50	.438	2740	2630	2393	2047	1507	1121	812
5	5.563	.50	2520	2419	2201	1880	1380	1026	743
6	6.625	.562	2368	2273	2068	1765	1293	961	696
8	8.625	.718	2323	2230	2029	1730	1267	942	682
10	10.75	.843	2182	2095	1906	1624	1187	882	639
12	12.75	1.00	2178	2091	1902	1621	1184	881	638
14	14	1.093	2169	2082	1894	1614	1179	877	635
16	16	1.218	2113	2029	1846	1572	1147	853	618
18	18	1.375	2118	2034	1850	1576	1150	855	619
20	20	1.50	2079	1996	1815	1546	1128	839	607
24	24	1.812	2093	2009	1828	1557	1136	845	612
Schedule 140									
8	8.625	.812	2647	2541	2312	1976	1454	1081	783
10	10.75	1.00	2612	2507	2281	1949	1433	1066	772
12	12.75	1.125	2468	2369	2155	1840	1350	1004	727
14	14	1.250	2500	2400	2184	1865	1369	1018	737
16	16	1.438	2517	2417	2198	1877	1378	1025	742
18	18	1.562	2426	2329	2118	1808	1326	986	714
20	20	1.75	2446	2348	2136	1824	1337	995	720
24	24	2.062	2399	2303	2095	1788	1310	974	706
Schedule 160									
⅛	.84	.187	3947	3789	3447	2973	2229	1657	1200
¼	1.05	.218	4017	3856	3508	3027	2271	1689	1223
⅜	1.315	.25	3873	3718	3382	2915	2183	1623	1175
½	1.66	.25	3006	2886	2625	2249	1663	1237	896
¾	1.90	.281	3093	2970	2702	2316	1715	1275	923
1	2.375	.343	3237	3107	2827	2426	1800	1338	969
1¼	2.875	.375	2960	2841	2585	2214	1636	1216	881
1½	3.50	.438	2939	2822	2567	2199	1624	1208	874
2	4.50	.531	3379	3244	2951	2535	1885	1401	1045
2½	5.563	.625	3201	3073	2796	2399	1778	1322	958
3	6.625	.718	3082	2959	2692	2308	1708	1270	920
3½	8.625	.906	2977	2858	2600	2227	1646	1224	886
4	10.75	1.125	2963	2845	2588	2217	1638	1218	882
5	12.75	1.312	2911	2794	2542	2177	1607	1195	865
6	14	1.406	2835	2722	2476	2119	1563	1182	842
8	16	1.593	2812	2699	2455	2101	1549	1152	834
10	18	1.781	2790	2678	2436	2085	1536	1142	827
12	20	1.968	2776	2665	2424	2074	1528	1136	813
14	24	2.343	2752	2642	2403	2056	1514	1126	845

Maximum allowable working pressure—6

Figures in table are maximum pressures, psi, for given temperatures and stresses. See June *Data Sheet 346* for basic formula used to calculate the table.

GEORGE C HALZELL, *Boston, Mass.*

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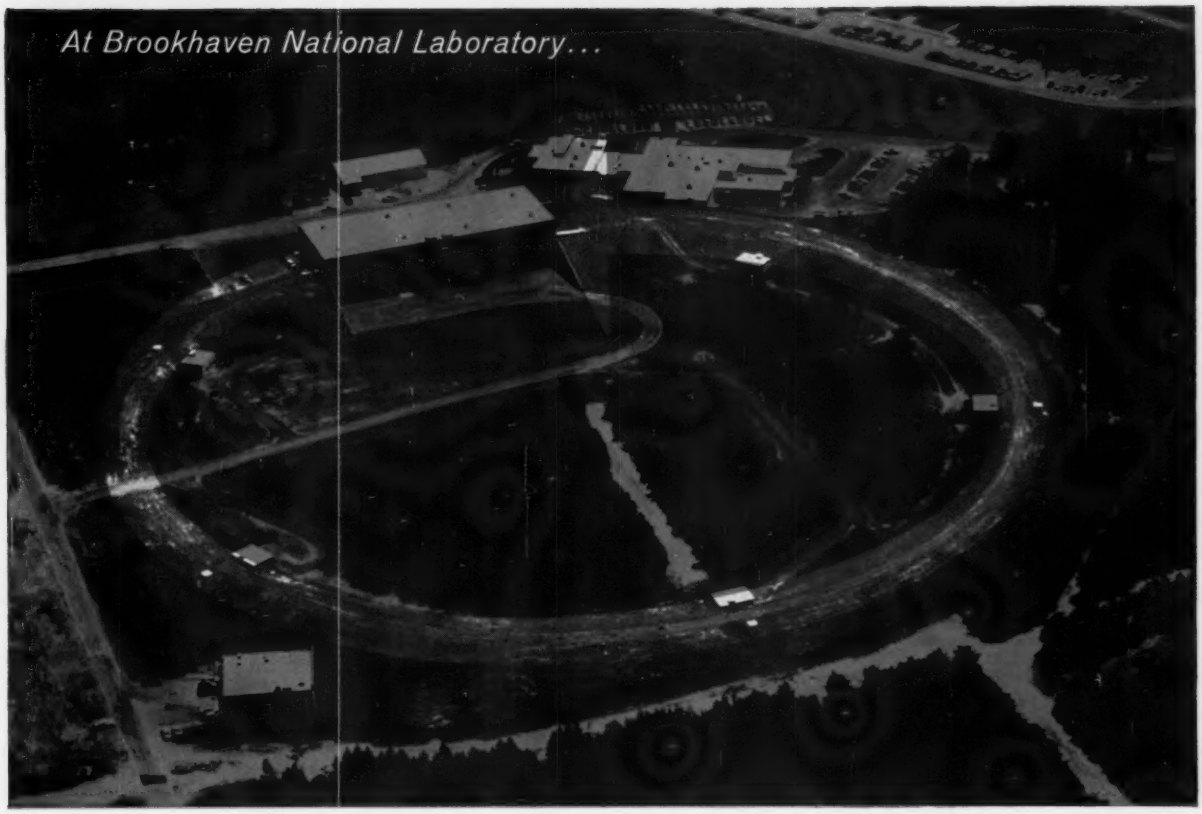

30 Billion Atom-Smashing Volts Keep On Target With Help Of A Sel-Rex Rectifier!

Promising to unlock the innermost secrets of the atom, the world's largest high-voltage proton accelerator circles underground—hidden from the casual observer beneath ten feet of earth and a carpet of new grass.

Named the Alternating Gradient Synchrotron, or AGS, the high voltage atom smasher is the pride of the famous Brookhaven National Laboratory, Upton, N. Y., home of many major achievements in atomic research.

Completed last year, the Accelerator sends pulses of high energy protons hurtling around a circular, half-mile course. This proton thrust steps up in speed and voltage as it circles counterclockwise along its track.

At the end of the high speed run, its protons are traveling at close to the speed of light. This surging force of 30 Billion Electron Volts, directed into a target building, is used experimentally to learn further secrets of the atom . . . to find new particles of matter.

At the heart of Brookhaven's AGS is a series of powerful electro-magnets which bend and focus the circling stream of protons. The vital focusing magnets which aim the high power proton force at the end of its trip are powered by D.C. current from a Sel-Rex silicon rectifier. The rectifier helps focus the shattering 30 Bev force precisely on target with essential reliability.

Just one of the thousands of important jobs Sel-Rex rectifiers are called upon to do in leading plants and laboratories, the Brookhaven application is one in which exacting standards were demanded—and met, as a matter of course!

And for your special current needs—for reliable, continuous conversion of A.C. to D.C.—choose Sel-Rex, the industry-proved rectifiers that more than pay for themselves in unequalled dependability and maintenance-free service.

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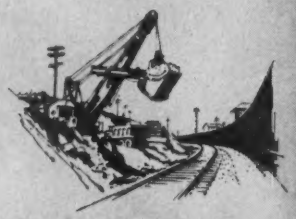
For more facts circle 242 on Reader Service card, p 99

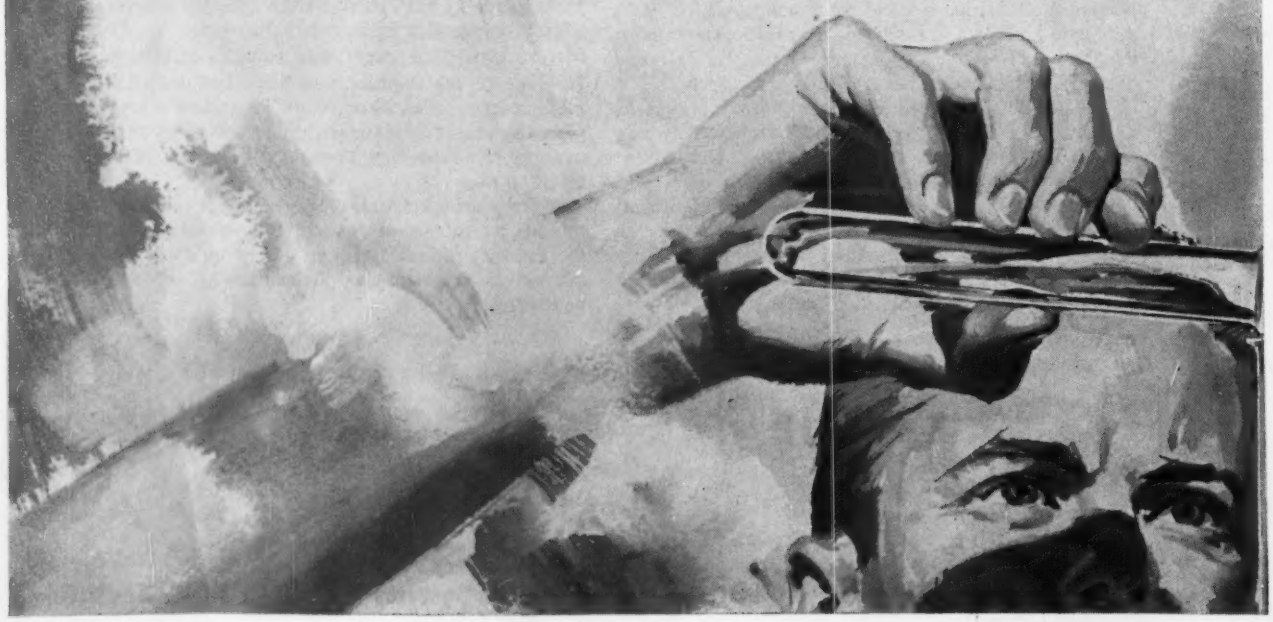
What the N&W-Has Meant to

Time Slashed: Installation of modern centralized traffic control (C. T. C.) and extension of passing sidings on the former Virginian . . . utilization of the best grades of both lines . . . elimination of interchanges . . . expansion and rearrangement of yards . . . better communications. These improvements cut time, speed coal trains over the road — save as much as 24 hours in transit from mines to N&W ocean terminal at Norfolk.



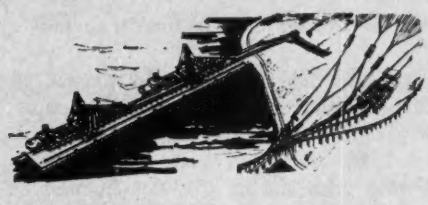
For upgrading the Virginian into a first-class, high-speed railroad, and for physical consolidation of the two properties, the N&W spent more than $7.4 million in the first year of the merger.

New Equipment: N&W has built and placed in service 1,000 85-ton roller bearing coal hopper cars (the first on any American railroad), and has started construction of another 1,000. These king size cars mean faster loading, hauling, delivery and unloading of bigger pay loads. Total cost, about $24 million.

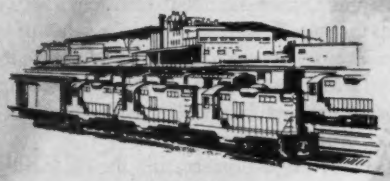


Virginian Merger the Coal Industry—

New Port Facilities: To increase efficiency, speed and loading capacity of export and coastwise coal at its Norfolk terminal, N&W is building the world's most modern and fastest-loading coal pier . . . new pier will increase loading capacity of N&W port facilities to more than 2,000 cars per day.



More Service: The N&W has strengthened its coal traffic department . . . organized a new fuel engineering department and increased research . . . opened new district coal offices to better serve producers and users . . . stepped up efforts to promote the sale of a greater variety of types and blends now available from the larger producing territory.

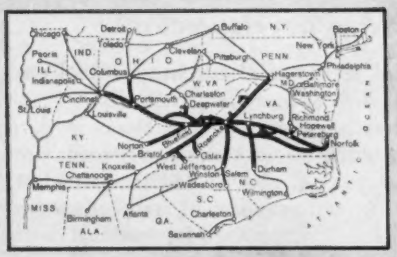


These are some of the more important benefits of the N&W-Virginian merger for the coal industry . . . some of the good reasons why we tell the world it pays to use the all-purpose quality coals mined along N&W lines.

N&W

NORFOLK and WESTERN RAILWAY

GENERAL OFFICES • ROANOKE, VA.



Nation's Going-est Railroad

For more facts circle 243 on Reader Service card, p 99

Technical briefs . . . A world-wide look at

To find out how to get more information on any of these papers, see box on p 94

How Russia trains and utilizes her engineers: EJC report tells the story

The training, placement and utilization of engineers and technicians in the Soviet Union U.S.S.R. annually graduates about 117,000 engineers compared to a current 38,000 for the U.S. And Soviet plans call for a substantial increase!

This report was prepared by The Engineers Joint Council and authored by experts in each area covered. Six sections detail education, planning and placement, postgraduate work, motivation, research and utilization.

Generally a Soviet freshman is better prepared for an engineering education than his American counterpart. There's a lot of motivation in the U.S.S.R.: a strong sense of patriotism, preferential compensation and higher standards of living (better housing and the possibility of obtaining luxuries such as an automobile or a *Dacha* — summer cottage). Other factors are social prestige exceeding that given Americans of like status and virtual exemption from military service.

But utilization of engineers in the U.S.S.R. doesn't measure up to their high degree of specialization. Example: a railroad engineer may for a time actually drive a locomotive. However, the Russians believe that their utilization practices are sound. Russian women engineers aren't used to the degree claimed, but nevertheless they remain a vital part of the Soviet professional manpower pool. *EJC*

Soviet engineering developments

Pressed wood, a material for mechanical engineering, *P N Khukhryanskiy, U.S.S.R.*
Pressed-wood parts, made from little blocks or thin plates of asp, alder, maple and similar woods are heated in water vapor, pressed and then dried at 230 to 266 F. Several examples of end-product use show this material's advantages for rubbing parts of instruments and engines. It excels in abrasive environments where lubrication is poor (such as water), under the effects of acid and at liquid-oxygen temperatures. *OTS 61-11,143, No. 6; Series IV, p 596*

Code of practice for the design of hydraulic structures — underground contour of dams on non-rocky foundations, *U.S.S.R. Ministry of Electric Power Stations*
Principles contained in this code apply to both normal and complex hydroelectric power stations and other hydraulic structures subject to hydrostatic pressure. Four main parts of the study: general provisions, design data, seepage calculations, computation of dam's resistance to piping. Related data, formulas and drawings are included in the appendixes. *OTS 61-21157 ($1.00)*

U.S.S.R. electric power — selected translations
These eight articles include the status and planned growth of Soviet electric power. Example: more power is now generated *each day* than during the entire year of 1920. And 1961 plans called for another 7800 mw. Also during '61, construction started on new plants totaling 15,500 mw. Their ultimate goal: complete electrification of the country. *OTS 61-3115 (75¢)*

Synchronous electromotors (DMK-1 and DMK-2) without contacts, *V V Apsit and V M Kutsevalov, U.S.S.R.*
Motors described in this abstract differ from common synchronous types because they lack a revolving exciting winding, collector rings and bushings. The two motors covered are rated 10 kw at 1000 rpm and 7.5 kw at 1500 rpm. Characteristics listed include efficiency, starting current and moment and weights. A cross section is included in the abstract. *OTS 61-11,143, No. 6; Series IV, p 482*

Engineering developments at the Leningrad Metal Plant *imeni* Stalin
Turbine manufacturing capabilities at the Leningrad Metal Works *imeni* (named in honor of) Stalin are revealed in a recent translation of the original 322-p Russian publication. Plant was established in 1857 to produce copper and brass sheet. But by 1928 it had become the leading hydraulic-turbine manufacturer in the U.S.S.R., and has held onto this position. Extensive technical-library facilities exist at the plant—currently 120,000 volumes. It subscribes to 88 foreign publications which are translated on request. *OTS 60-51160 ($3.25)*

Cooling towers

Cooling tower or cooling pond—an appraisal, *W R Steur, Sargent & Lundy, Engineers*
While local conditions will dictate the choice between cooling towers and cooling ponds in many cases, some installations do enjoy freedom to choose by evaluation. Factors in such an evaluation process

include not only local conditions but also differences in operating characteristics of these two cooling methods. Example: dry-bulb temperature is the reference for pond performance while wet-bulb temperature is the key in most towers.

When you're considering cooling towers, remember that there are two general types—induced and natural draft. Operating differences between them are significant. But for either type, auxiliary power will run higher than pond needs since cooling water must be pumped above the tower base. Requirements will be higher yet for an induced-draft tower because it has fans to draw extra power.

On the other hand, cooling ponds cover a lot of territory. As a rule of thumb, one to two acres are required per mw of generated power. Other pond negatives: seepage and "people problems"—recreational-facility regulation.

A tabulated sample comparison of differential costs is included for several schemes: river, lake, mechanical- and natural-draft cooling towers. *APC*

Comparing mechanical- and natural-draft cooling towers, *T H Hamilton, Fluor Products Co, Santa Rosa, Calif.*

The precise combination of peak loads and weather conditions that exists in Britain and makes hyperbolic cooling towers practical there is missing in most of the U.S. The hyperbolics perform best when low wet-bulb temperatures combine with high relative humidities. Yet the first U.S. hyperbolic tower is slated to go on the line in 1962 on a 265-mw unit. This tower will cool 120,000-gpm condenser circulation. It will be 325-ft high by 245-ft dia (announced in POWER, September 1960, p 68).

Comparing mechanical- with natural-draft cooling towers is a complex process since operation of each depends upon a different set of variables. An evaluation for one locale may be completely invalid at another site. Since there is little information elsewhere available, this paper details method of sizing and rating a natural-draft tower. Several evaluations for a variety of typical operating conditions compare price and performance. *REA*

Standards on water-cooling towers, May 1961, *National Fire Protection Assn*

These new standards cover all cooling-tower types, atmospheric and mechanical-draft, and establish fire-protection criteria. Since many usual construction materials are combustible, fire risk is high even in operation. Many cooling-tower fires are caused by ignition from outside sources such as incinerators, stacks or open fires, so putting a good distance between tower and fire source is a primary consideration when locating your cooling tower.

Ignition from within must be considered, too. Included here are electric sources in induced- or forced-draft towers. Hazard is exceptionally high during construction, when combustible materials are dry and highly flammable.

Detailed sections cover such topics as location, installation of electric equipment and wiring and fire-prevention systems. Latter include access, exposure protection, hydrants and water supply.

Since good tower maintenance goes a long way toward preventing fires, one section covers such items as housekeeping, smoking and mechanical and structural inspection. *NFPA No. 214*

Automatic control

Automatic programing for optimized power-plant designs, *F H Westervelt, University of Michigan, C D Birget, Commonwealth Associates and F C Fisher, Consumers Power Company*

Control, design and analysis problems of the electric-utility industry lend themselves to solution by the digital computer. While physical principles and operating data are readily available and understood, techniques are not developed to the extent the industry would like. To improve this situation, the authors' companies and Michigan U joined forces on the 2-year program reported.

Power-plant-optimization method requires extensive use of "stepwise-regression program with simple learning." With this powerful tool, the wealth of information already available in operating records can be studied and reduced to analytical terms. It becomes possible to recognize quantitatively when a plant component is no longer turning in its best mechanical and economic performance. The design engineer is able to study more variations and configurations of plants per dollar invested than ever before. *APC*

Dynamic representation of a large boiler-turbine unit, *J H Daniels, Philadelphia Electric Co, Mark Enns, Westinghouse Electric Co and R D Hottenstine, Combustion Engineering Company*

Using the Cromby Station of the Philadelphia Electric Company, a mathematical model was developed by writing a set of nonlinear lumped-parameter equations. These were subsequently linearized and transformed for solution. Results reported are the first solution of such a model for a large steam-electric generating unit.

Appendixes show development of equations for many plant components. *ASME 61-SA-69* continued

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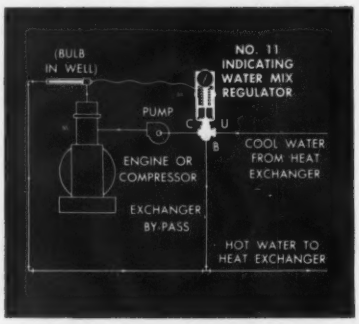
HOW AND WHAT TO INSTALL FOR JACKET WATER COOLING CONTROL

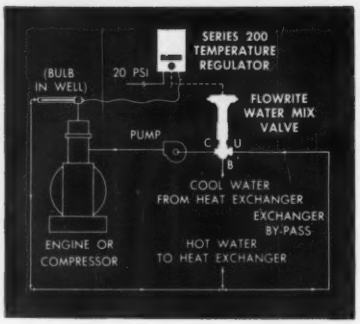
For economy and simplicity—

Install indicating water mix temperature regulator so that heat exchanger by-pass is connected to bottom port. Connect cool water from exchanger to upper port and pump suction to common port. Locate thermal bulb of regulator in warmed water outlet of engine or compressor. Use of a separable well permits bulb removal without draining system.



For remote location of temperature regulator—

Install water mix valves so that heat exchanger by-pass is connected to upper port, cool water to bottom port and pump to common port. Locate temperature regulator where convenient. Thermal bulb and well procedure is same as system above. Use of a reverse-acting temperature regulator prevents engine overheating in event of compressed air failure.



Request Powers *Engineer's Manual, Steam-Water Service* for full details and description of components. Free to anyone engaged in steam and water service, this manual gives the "how and what" for all types of systems and controls. You'll find it a practical, easy to follow guide for recommending or laying out new installations or updating old ones.

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In Canada: The Powers Regulator Co. of Canada Ltd. Downsview, Ontario

Technical briefs

Begins on page 92

To obtain complete text

Material for these abstracts comes from the following sources. Order complete paper from source, *not* POWER.

EJC: Engineers Joint Council, 345 E 47th St, New York 17, N.Y. $1.00.

OTS: Office of Technical Services, U.S. Dept of Commerce, Washington 25, D.C. Prices as indicated. Where papers were abstracted from *Series IV*, contact OTS for details on "English abstracts of selected articles from Soviet-Bloc and Mainland-China technical journals." These abstracts are not available individually.

REA: Rural Electric Generating Cooperatives Conference. In most cases, complete papers are available direct from the author at no charge.

APC: American Power Conference, Illinois Institute of Technology, Technology Center, Chicago 16, Ill. Papers will be published as a book costing $10.00.

NFPA: National Fire Protection Assn, 60 Batterymarch St, Boston 10, Mass. 50¢.

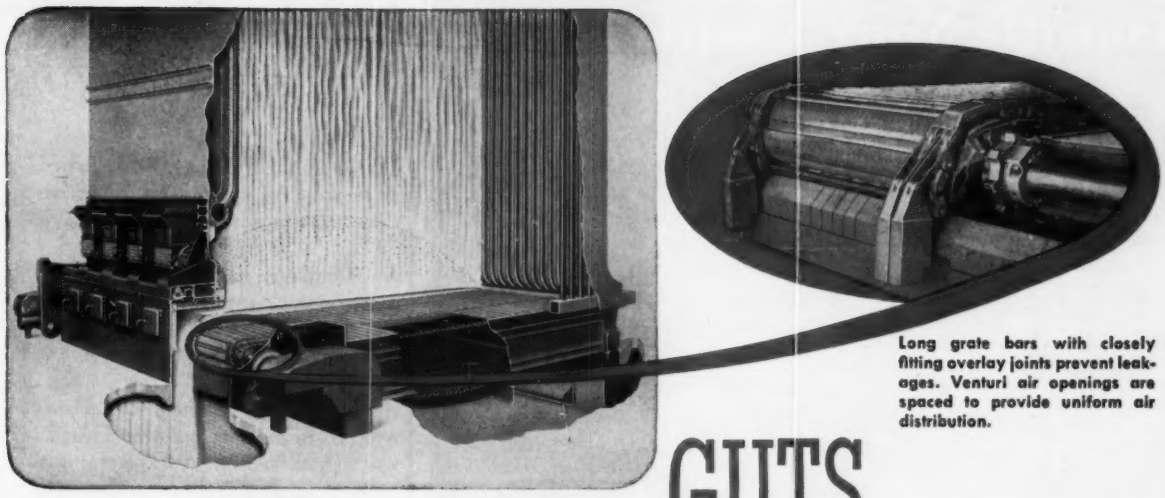
ASME: American Society of Mechanical Engineers, 345 E 47th St, New York 17, N.Y. Members, 50¢; non members, $1.00.

Burners

Development of a combination liquid- and gas-fuel burner system for thermoelectric generators, *Larry Selwitz, Westinghouse Electric Corporation*

This study involves a 500-w thermoelectric generator which, at 5% efficiency, requires 10,000-w heat input. Core heat absorption was 55.5 w per sq in. This 5% efficiency is based on convective heat transfer alone, but recently work has been done on increasing heat-transfer rate by radiation *and* convection.

Both propane and gasoline fuel systems were studied—latter are the more complex. Fuel handling and



Long grate bars with closely fitting overlay joints prevent leakages. Venturi air openings are spaced to provide uniform air distribution.

GRATES ARE THE GUTS OF A STOKER

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No matter what else it has, no stoker can be a complete success without trouble free efficient grates.

The Detroit RotoGrate Stoker has other outstanding features in abundance but without the superior grate design it could never have achieved such instant and lasting success.

The advent of the RotoGrate Stoker established a whole new trend in coal firing and stimulated many competitors but none has seriously challenged the superior performance and long life of the RotoGrate.

Our grates are high resistance metering type with venturi air openings spaced to provide uniform air distribution. Long grate bars have close fitting overlay joints to prevent leakages that cause blow holes and burnouts.

Sturdy construction and use of special alloy iron makes these grates long lasting under the most exacting service.

Guide chains riding over toothed sprockets assure positive grate bar alignment. A unique method of attachment avoids chain wear and stretching, while the catenary take up of slack prevents jamming.

Forward travel continuously discharges ash. Automatic combustion control varies the speed of travel in step with fuel feed rate to maintain uniform fuel bed while following fluctuations in load.

Burns all grades of bituminous and lignite coals, also many kinds of refuse and by-product wastes.

The RotoGrate for boilers to 400,000 pounds steam per hour capacity; other Detroit Stokers for capacities from 3,000 pounds steam per hour.

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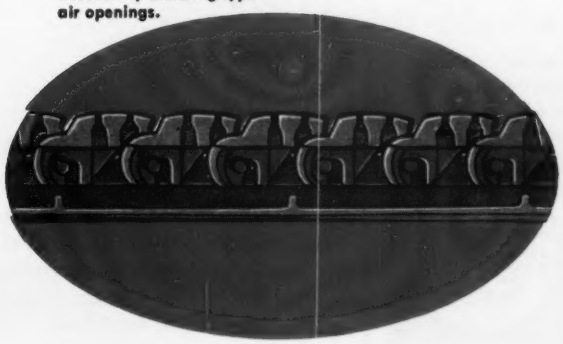
Cost equals initial investment plus upkeep plus production losses due to equipment outage. The total is less with Detroit.

Even distribution of air is assured by metering type air openings.



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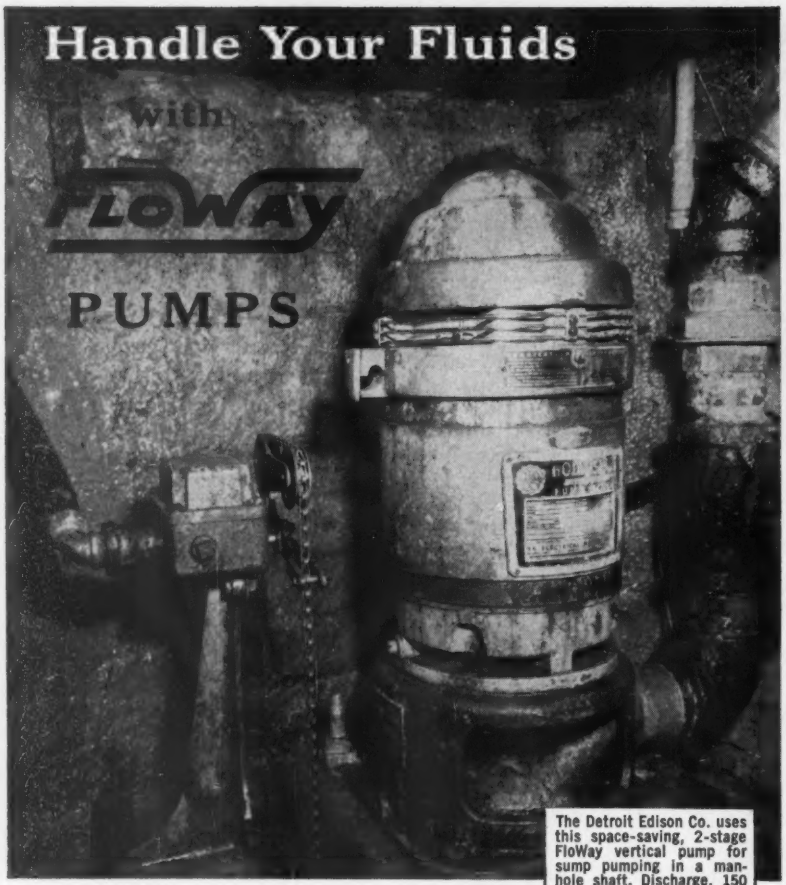
For more facts circle 245 on Reader Service card, p 99



The Detroit Edison Co. uses this space-saving, 2-stage FloWay vertical pump for sump pumping in a manhole shaft. Discharge, 150 gpm at 90' tdh with 5 hp, 3600 rpm motor.

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1

FLOWAY Pumps

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Technical briefs

Begins on page 92

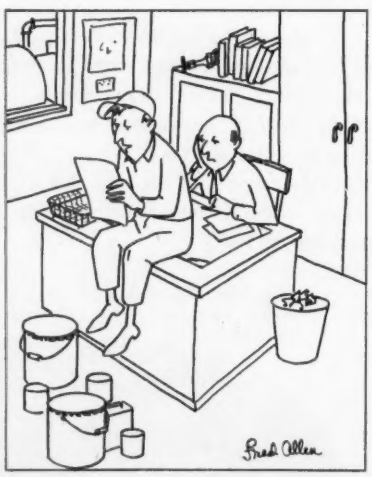
burner configurations are discussed, a glossary of thermoelectric-generation terms included. *ASME 61-SA-56*

Application of burner safety-supervise controls to existing gas-fired central-station boilers, *C J Henne, City Public Service Board, San Antonio, Texas*

Application of burner supervisory controls to existing gas-fired furnaces has gained recently for several reasons—among them, increased number of furnace explosions. And as units are relegated to peaking service, daily startup and shutdown increase this risk.

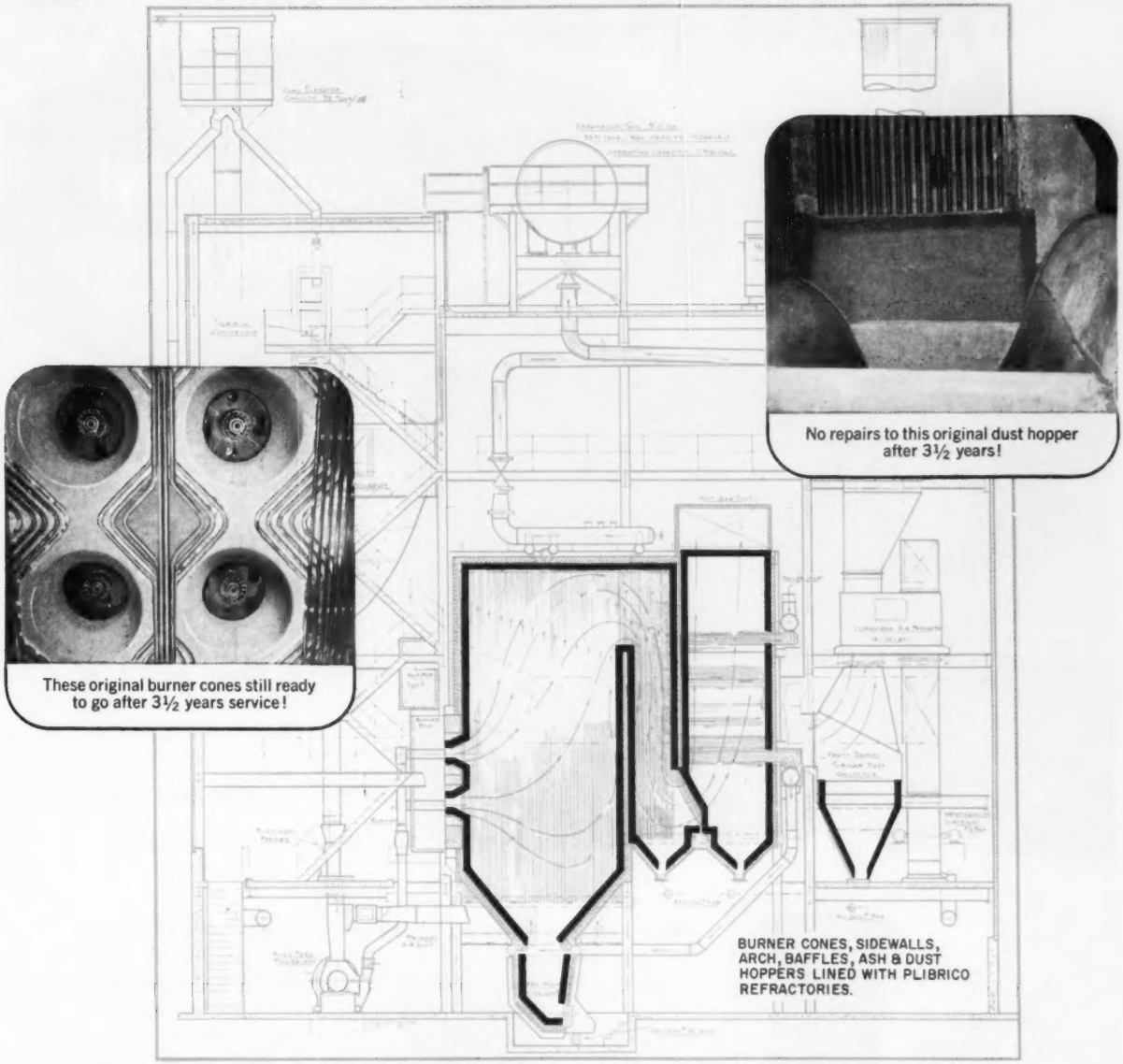
Effectiveness of controls is based on three needs: (1) positive, safe operating procedure; (2) positive and speedy corrective measures in case of malfunction (3) high reliability.

Both local and remote system control stations are needed for maximum flexibility and safety. Control features include supervised startup and shutdown, indication requirements, power requirements, control components and detectors. *ASME 61-SA-54*



"Now for the condensate lines I had in mind a lavender striped with gold —they're both big colors this year. The feedwater lines I thought would look good in flamingo with the flanges canary yellow. The high pre. . . ."

Behr-Manning cuts operating and maintenance costs to new low with industry's largest, high-temperature hot water system


No repairs to this original dust hopper after 3½ years!
These original burner cones still ready to go after 3½ years service!
BURNER CONES, SIDEWALLS, ARCH, BAFFLES, ASH & DUST HOPPERS LINED WITH PLIBRICO REFRACTORIES.

System designed by Behr-Manning Co., J. O. Ross, consultant

Only $133.82 refractory repair costs in 3½ years ...with Plibrico Monolithic "Zoned" linings!

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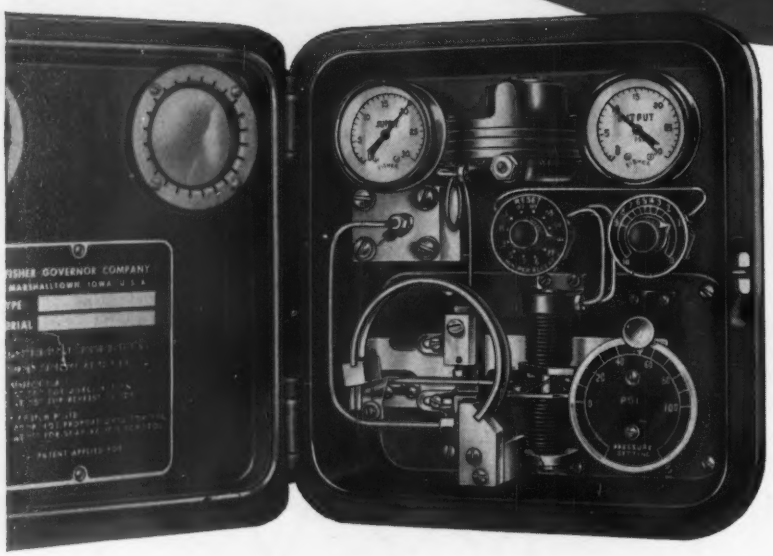
Written by Behr-Manning engineers gives complete details about largest, h-t, hot water system. Plibrico Catalogs 68 & 71 cover refractories used.

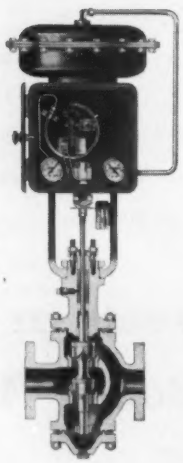
For more facts circle 247 on Reader Service card, p 99

the Fisher/man shows how to get.....

Accurate pressure control in spite of demand changes



WIZARD II
Pressure Controller



WIZARD I
PRESSURE CONTROLLER

The original Wizard I Pressure Controller is still available for those applications not requiring volume relay or reset features. The simplicity of a self-operated regulator and the accuracy of a pilot or relay operated regulator are found in the Series 4100U. This is, unquestionably, the reason for the continued popularity of the Wizard I series.

● Faster response to pressure changes provided by volume relay ● Pin-point control made possible by reset feature, adjustable from .005 to 1 minute per repeat ● Wide pressure ranges handled by brass, steel or stainless steel Bourdon tubes for 30 to 15,000 psi, Bellows assemblies for pressures below 30 psi and vacuum ● Easily reversed from direct to reverse action without additional parts ● Universal mounting on a wall, panel, or on yoke of control valve ● Compact construction consists of two sub-assemblies encased in weatherproof die cast aluminum housing, either can be removed without disturbing case mounting. *Write for bulletin No. D-4150B or D-4100 on Wizard I.* Fisher Governor Company, Marshalltown, Iowa. Plants in Woodstock, Ont., Rochester, England. Butterfly Valve Division: Continental Equipment Co., Coraopolis, Pa.

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New free literature

General equipment and key materials for systems engineering

101 **"How to choose shielding gas"** is title of 8-p reprint. Gases for metal welding—consumable- or nonconsumable-electrode process—are described. Air Reduction Sales Company

• **Instrumentation**

102 **Thermowells** for test instruments are topic of 6-p folder TT-302. Dimensional info and materials listing for each type are included. Trinity Equipment Corp

103 **Multipoint gages** indicate draft, pressure, differential and temperature. Installation and mounting dimensions are diagramed in 4-p circular 322.11 from Republic Flow Meters Company

104 **Recorders**—direct and servo operated, switchboard and portable—are subject of 12-p bulletin GEA-6933A. Units are available at ¼, 3/10, 1, 2 and 3% accuracy. General Electric Company

105 **Differential pressure gage** indicates up to 60 psid in systems to 3000 psi. Data sheet E10 is offered by Pall Corp

106 **Time meters** are detailed in 4-p publication GEZ-3354 available from General Electric Company

107 **Pressure transmitters,** differential, pneumatic and electric, are featured in spec sheets G21-4, P21-4 and E21-4 respectively. Bailey Meter Company

108 **Data systems** are for alarm scanning and digital recording of any type or combination of analog values. 8-p folder is available from Monitor Systems, Inc

109 **Digital process controllers** can be used to count, measure, indicate and control. Range: 0 to 180,000 counts per min. Data sheet 201-A gives details. Digital process controllers and totalizers are topics of data sheet 202-A. The Louis Allis Co

110 **Solids flowmeter** measures granular materials — coal, ore and crushed rock—in vertical ducts, spouts or pipes. Spec sheet M22-6 is from Bailey Meter Company

111 **Pneumatic temperature** transmitter installation and application is illustrated in 12-p catalog 13-17C. Unit compensates automatically for ambient-temperature and pressure changes. The Foxboro Company

112 **Pressure gages** in 3- and 5-in. dial sizes are designed to maintain accuracy under overload pressure, shock and high vibration. 4-p literature 280 is offered by American-Standard Controls Div

113 **Panel instruments** come in dc, ac and moving-iron ac rectifier types. 6-p bulletin 01-111 gives

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Air-conditioning systems 104
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ordering info—dimensions, power consumption and accuracies. Daystrom, Inc, Weston Instruments Div

114 **Strip-scale indicating receiver** can be used singly or gang-assembled for horizontal or vertical mounting. Data sheet A113.1.3-10 gives features. The Bristol Co

115 **Pressure testers,** dead-weight and comparator types, are rated to 13,000 psi. Units come in two classes: for use with distilled water and for oil testing. 4-p bulletin is available from Mansfield & Green Inc

116 **Closed-circuit TV** is used for surveillance. 10-p brochure features camera small enough to fit in a 3-in. pipe. Electronics Div, Fairbanks, Morse & Co

• Maintenance

117 **Balancing-machine** specifications are contained in 16-p bulletin 24-1. Optional accessories convert electronic unit to portable balancer. Stewart-Warner Corp, Industrial Balancer Dept

118 **Industrial vacuum** 29-p handbook presents 79 cost-cutting ideas to reduce cleaning costs. Breuer Electric Mfg Company

119 **Electronic leak detectors** are portable. They're halogen-sensitive to locate pressure and vacuum leaks as small as 1/100 cu in. per day. 8-p bulletin GEA-6817A is from General Electric Company

120 **Pressure-sensitive tape** selection is topic of 4-p bulletin DB-56A. Construction and troubleshooting are chapters. Johns-Manville, Dutch Brand Div

121 **How to detect** and correct torque-output loss in older impact tools is covered in 4-p publication. Skidmore-Wilhelm Manufacturing Company

122 **Steam-detergent cleaning** methods and materials are presented in 4 pp. Oakite Products, Inc

123 **Air-powered equipment** for materials-dispensing applications is subject of 32-p catalog 42. Equipment shown: pumping systems to dispense paint, caulking compounds and sealers and similar fluid or semifluid materials. Lincoln Engineering Company

• Piping, valves, fittings and specialties

124 **Pipe** to solve special pressure and corrosion problems is centrifugally cast, glass-fiber reinforced. Three bulletins give details: one gives physical properties, applications. Second shows pipe in structural use and third includes technical and spec data in its 16 pp. Fibercast Company

125 **Pipe insulation** combines metal jacketing and high-temperature calcium silicate. 8-p brochure IN-217A gives pipeline coding methods as well. Johns-Manville

continued

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NEW FREE LITERATURE continued ..... circle key numbers, page 99, for your copies

126 **Gate valves** are designed to withstand corrosive actions too severe for lighter valves. Two types are described in 4-p circular 561: bronze mounted with iron body and all-iron. Lunkenheimer Co

127 **Ball valves** with removable cartridge containing seats, ball and stem are introduced in 8-p brochure ADB-1001-561. Crane Co

128 **Solenoid valves**, 2, 3 and 4 way, are topic of condensed supplement. Catalog sheets on new units bring booklet up to date. Automatic Switch Company

129 **Control valves**—pneumatic diaphragm and piston actuators, valve-body assemblies — are subject of 64-p manual E600. Pressure-drop tables are given. Fisher Governor Company

130 **Surge-arrester valve** anticipates surge to protect system. Pilot controls open the main valve automatically on abnormal pressures or power failure. 16-p catalog W-16 is offered by Golden-Anderson Valve Specialty Company

131 **Control valve**, diaphragm actuated, is covered in spec sheet SRM 709.22. Republic Flow Meters Co

132 **Solenoid valve** spec sheet 710-Q covers seven models in ⅜- to 2-in. sizes. J D Gould Company

133 **Drain or sampling valve** is built to meet high temperatures or for corrosive service. Data sheet 400 gives details. Jerguson Gage & Valve Co

134 **Stainless-steel ball valve** for corrosive fluid and gas service is described in catalog sheet 612. Lunkenheimer Co

135 **Ball valve** 4-p brochure helps you select correct size, combination of metals, seals, seats and pipe ends. Worcester Valve Company, Inc

136 **Flow nozzle** handles high pressures, temperatures and thermal stresses found in steam-generating plants. Spec sheet 134.201-1 is from B-I-F Industries, Div of New York Air Brake Company

137 **Tube fitting** has identical ends so you can't put it in backwards. Made in stainless steel and in brass, it's featured in 20-p catalog 4323. Parker Fittings & Hose Div, Parker-Hannifin Corp

138 **Ductile-iron pipe fittings** are topic of 12-p booklet. Ratings: screwed fittings, from 300 to 2000 psi; pipe-lock couplings, 400 and 800 psi; flanges and flanged fittings, 150- and 300-psi class. The Kuhns Bros Co

• **Materials**

139 **Silicone fluids** used as hydraulic and damping fluids, dielectrics and lubricants, castings and antifoam agents are subject of 20-p publication S-9. Viscosity vs temperature and fluid-blending charts are found. General Electric Company

140 **Silicone rubber uses**—and abuses—are topics of 60-p book. With charts and illustrations, it serves as reference book for the designer. Specifications help determine which type for you. One chapter defines commonly used words. Mechanical Rubber Products Co

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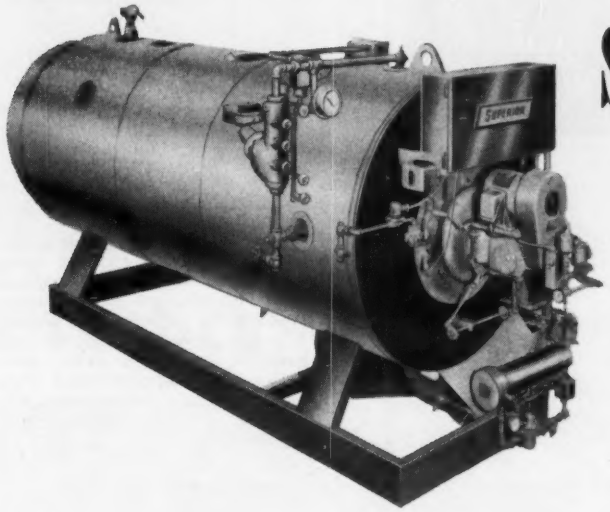


specify over 50% of all

SUPERIOR
PACKAGED BOILERS

Qualified by both training and experience to specify for their clients boiler equipment which meets the requirements of the installation and *complements the consultant's selection* by its record of performance, Consulting Engineers are responsible for more than half of the Superior Packaged Boilers installed.

This interesting fact was revealed in a recent market-analyzing survey of Superior Sales Engineers when they were asked who was responsible for the purchase of the boilers they had sold in the past year.

There is a reason for this in basic principles of engineering design which make Superior Boilers pay dividends in long-lived satisfaction to their owners.

Skilled in evaluating boiler equipment feature by feature, Consulting Engineers appreciate Superior's conservative capacity ratings based upon a full 5 sq. ft. of heating surface per unit of Hp. They realize that Superior's 4-pass design . . . their induced draft . . . their dependable rotary burner for firing gas or oil . . . and their dimensional compactness . . . are features which result in installation and operating economies for the owner, as well as favorable recognition for the consultant.

And last, but not least, Consulting Engineers appreciate the importance of unit responsibility . . . that Superior Packaged Boilers are shipped *complete,* after factory fire testing, and are backed by the undivided responsibility of their maker.

Superior Packaged Boilers are engineered and produced by a manufacturer who is dedicated to packaged boilers *exclusively*...a firm which is as proud of its product's reputation for performance as is the Consulting Engineer of his professional standing.

These are all good reasons why YOU should choose a Superior Packaged Boiler for YOUR installation.

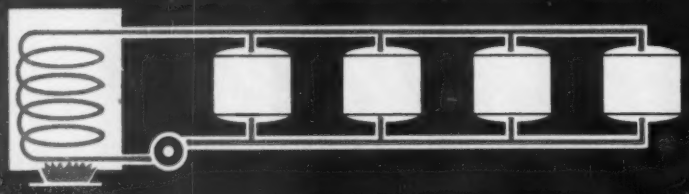
Fire tube boilers for steam or hot water are supplied in sizes to 600 Bhp. Water-tube boilers up to 72,000 lbs./hr. For complete details, write for Catalog S-11.

Fire-Tube and Water-Tube PACKAGED BOILERS
for STEAM or HOT WATER
SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N. Y.

SUPERIOR
PACKAGED BOILERS ®

For more facts circle 249 on Reader Service card, p 99

FOR MINIMUM COST + MAXIMUM EFFICIENCY



Systems operating on Monsanto *Thermal Fluids* deliver process heat up to 600° F. from unpressurized *liquid*

SAVE BIG! Now, with Monsanto *Thermal Fluids*, you can install a process heating system that will generate up to 20 million BTU per hour and deliver the heat as an unpressurized liquid to multiple use points! Needs no vapor traps, gas blankets, pressure piping, vaporizers, condensers, or other fancy "gadgets." Needs no costly, space-filling safety devices. No water conditioning; no pressure danger; no fire danger—*you do not need a licensed engineer to operate a Thermal Fluid system!*

SPEED OUTPUT! With heat delivered via a liquid *Thermal Fluid*, you cut maintenance to the bone (no corrosion, no fouling of tubes, pipes, pumps, or coils); heat evenly (*no hot spots*); control temperature on-the-button (*to within 2° F.*). Result: better quality resins, foods, pharmaceuticals, dyes, hydrocarbons, chemicals—*plus* increased production (*in some cases up to 50% more*)!

SAFETY, TOO! You can forget worrying about fire and explosion! Monsanto *Thermal Fluids* won't support combustion. Can't even be ignited by the direct flame of a blowtorch!

This recent report tells the safety story:

"My operator fired the gas heater but failed to start the circulation pump. The coil overheated and ruptured. The Monsanto fluid poured into the firebox. There was a lot of smoke, of course, but no external fire. And as soon as the heater was cut off, the smoking stopped immediately!"

Mail This Handy Coupon Today for Design Engineering Data

MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
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Monsanto

Please send me: ( ) Technical Bulletin 1248 on Monsanto *Thermal Fluids;* and ( ) list of heating system designers and heater manufacturers.

NAME.....

COMPANY.....

STREET.....

CITY..... *ZONE*..... *STATE*.....

Free literature

Begins on page 99A

141 **Beryllium structural bolting** history is found in 16-p booklet 2719. Company's research and development program is traced to fabrication of a headed and threaded fastener. Standard Pressed Steel Co

• Prime movers

142 **Power and expansion engines,** engine- and motor-driven compressors are some of equipment pictured in 14-p catalog. Company's services are listed. The Cooper-Bessemer Corp

143 **"Problems in the design of steam turbine plant"** is title of 108-p comprehensive book. Chapters deal with strength and vibration problems in construction, ability of steam power stations with reheat to deal with heavy load peaks, computation of heat cycle using digital computers. Allgemeine Elektricitats - Gesellschaft

• Heat exchangers

144 **Finned heat-transfer tube** is detailed in 8-p brochure. In most cases tube can be substituted directly for regular tube in existing heat-transfer units. Scovill Manufacturing Company, Mill Products Div

145 **Stainless-steel condenser tubing** applications, history and performance data are found in 12-p booklet. Allegheny Ludlum Steel Corp

146 **Heat exchangers** for controlled steam heating of water are subject of 30-p catalog AX60. There's a combination index and rating chart to aid sizing. A typical hookup is diagramed. The Alstrom Corp

147 **Removable - bundle** heat - exchanger construction is illustrated in 6-p folder 0-1162. One feature: double O-ring seal protection on units with 6- to 16-in. shell dia. Basco, Inc

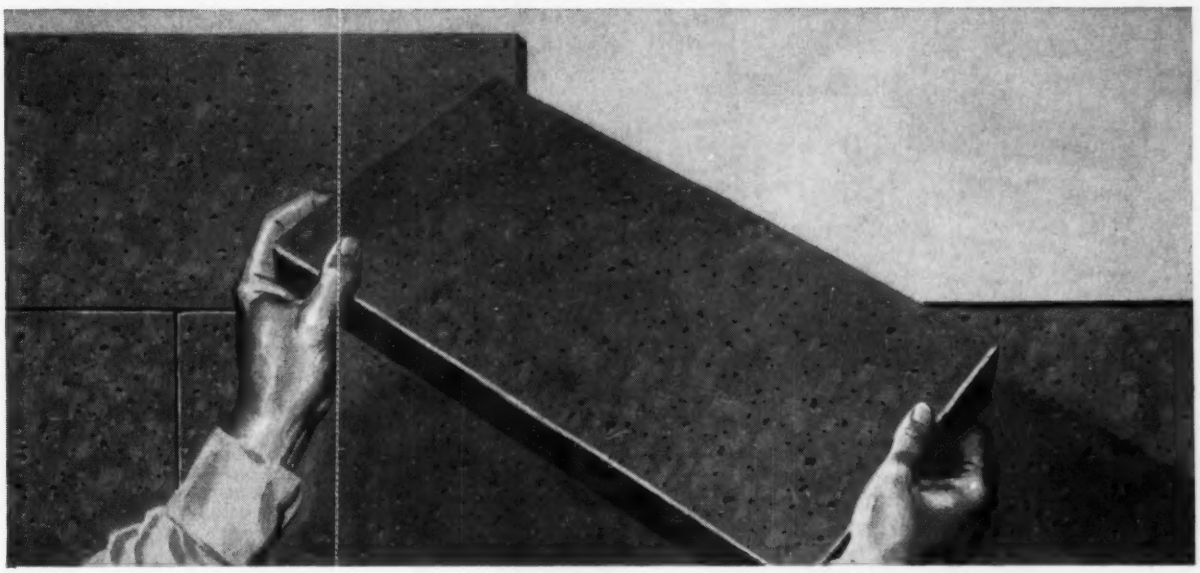
148 **Steam coils** are topic of catalog 305. Some features: staggered-tube design, copper tube headers and rippled-corrugated fins. McQuay, Inc

149 **Coil** is subject of bulletin 404-2 which contains capacity, air and refrigerant pressure-drop info. McQuay, Inc

150 **Compact exchanger's** sizes, dimensions and weights are listed for 1-, 2- and 4-pass units in 4-p circular F-1161. Basco, Inc

151 **Heat-transfer surface** 24-p brochure 356 contains charts and tabulations: refrigerant and saturated-steam properties, deter-

A TRUE-CUT BLOCK WITH PRECISION-FINISH!



- Eagle-Picher's "precision-finish" is one of the most important insulation developments in years.
- Highly efficient, all-purpose block that is practically dustless.
- Great structural strength! Meets rigid demands for long-lasting block able to withstand wide temperature range up to 1900 F.
- Lightweight, easily installed! Easily cut to fit irregular areas—no special tools needed. Requires only minimum reinforcing.
- Effectively resists steam and other moisture! Does not disintegrate or lose thermal efficiency under heavy duty service.

EAGLE-PICHER
PV SUPERTEMP
BLOCK INSULATION

This Mineral Wool Insulation conforms to COMMERCIAL STANDARD CS-117-49 as issued by U.S. DEPARTMENT of COMMERCE.

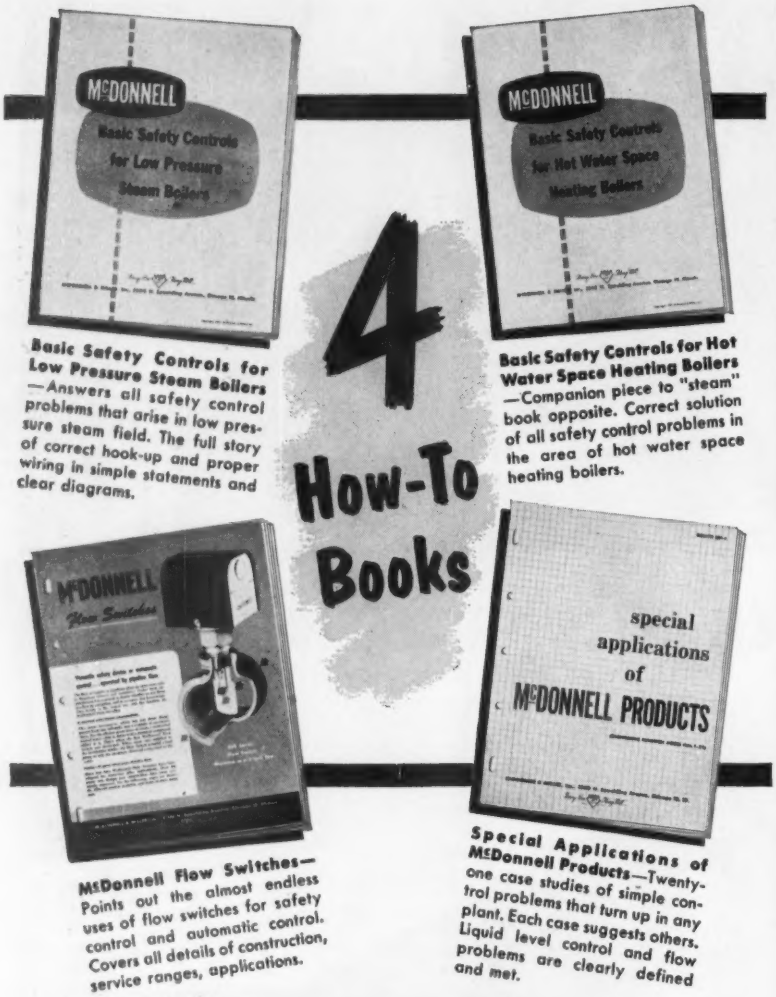
Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

EAGLE-PICHER / Manufacturer's Manufacturer

Since 1843 / The Eagle-Picher Company
Dept. P-1161
Cincinnati 1, Ohio

EAGLE EP PICHER

For more facts circle 251 on Reader Service card, p 99



Basic Safety Controls for Low Pressure Steam Boilers—Answers all safety control problems that arise in low pressure steam field. The full story of correct hook-up and proper wiring in simple statements and clear diagrams.

Basic Safety Controls for Hot Water Space Heating Boilers—Companion piece to "steam" book opposite. Correct solution of all safety control problems in the area of hot water space heating boilers.

McDonnell Flow Switches—Points out the almost endless uses of flow switches for safety control and automatic control. Covers all details of construction, service ranges, applications.

Special Applications of McDonnell Products—Twenty-one case studies of simple control problems that turn up in any plant. Each case suggests others. Liquid level control and flow problems are clearly defined and met.

—for every engineer

Here are four bulletins that can make a basic contribution to the things every operating man seeks...more efficient operation... automatic operation...safer operation.

Read the brief descriptions of these booklets. ***Use the coupon to request any or all of them.***

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COUPON BRINGS THEM—

Send me a copy of bulletin(s) checked:

- ☐ Steam Booklet, L-711
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Mail to: McDonnell & Miller, Inc., 3506 N. Spaulding Ave., Chicago 18, Ill.

Free literature

Begins on page 99A

mining heating surface, U values, pipe-coil equivalent areas. Dean Products, Inc

152 **Heat-transfer** 12-p design manual HDM-761 gives graphical solutions to heat-transfer problems in Btu per sq ft per hr and watts per sq ft vs temperature difference. Electrofilm, Inc

- **Lubrication**

153 **Lube oil** works in extremely wet conditions; ten viscosity grades are described in spec sheet 17. Industrial Products Dept, Sun Oil Company

154 **"Industrial lubricants"** is title of 16-p brochure. Outlines how to streamline your lube program and cut costs. The Pure Oil Company

155 **Lubrication systems**—direct, single and dual line, oil circulating and constant pressure—are detailed in 36-p booklet from Research Appliance Company

156 **Grease lubricant** has high molybdenum-disulfide concentration — for extreme-pressure applications. Data sheet 131 is from the Alpha-Molykote Corp

157 **Bottle oilers** for plain bearing lubrication, oil-level controls and oil cups are covered in 4-p circular 580. Lunkenheimer Co

Air-conditioning systems

158 **Involute cycle dust-collector** operation is outlined in 4-p folder 180. John Wood Company, Air Pollution Control Div

159 **Electrostatic precipitators** eliminate oil mist and smoke generated by grinding and machining operations—see 4-p bulletin 240 from John Wood Company, Air Pollution Control Div

160 **Electronic air cleaners** with pushbutton control are described in 6-p publication 1435. Westinghouse Electric Corp

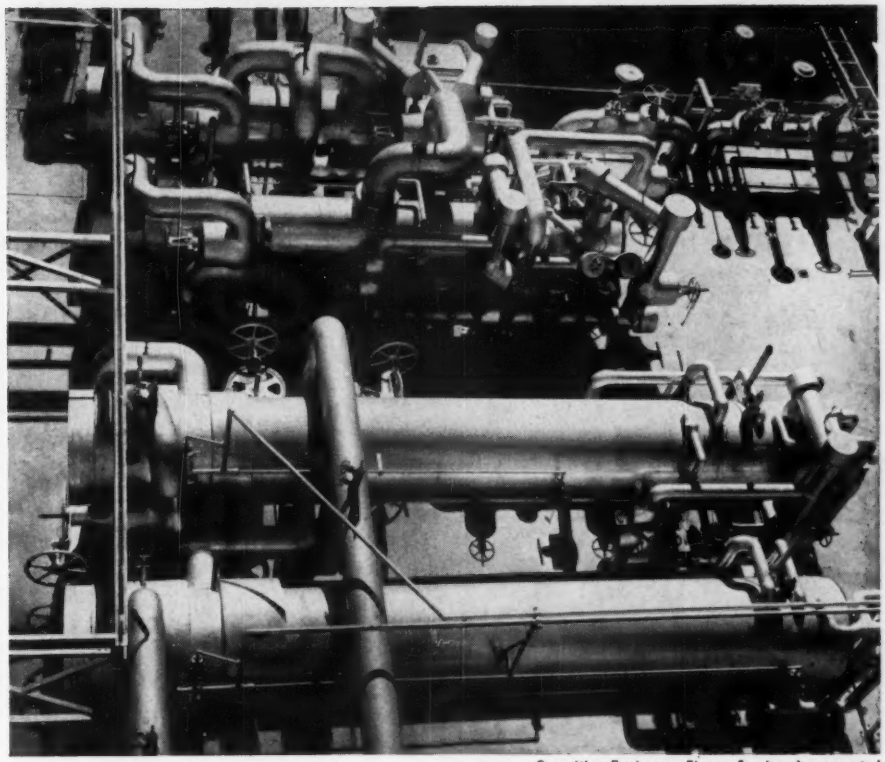
- **Air-conditioning equipment**

161 **Compressors,** condensers, coils and an air-handling unit are detailed in: 58-p application manual 789, catalog 790, selection guide 6001A and bulletin 6011C. Dunham-Bush, Inc

- **Heating**

162 **Infrared radiant heat** is explained in 4-p circular. Out- and indoor applications are pictured. Fostoria Corp

163 **Space heaters,** oil and gas fired, steam thawers and a portable hot-water heater are covered in



Consulting Engineers: Ebasco Services Incorporated

4,000 PSI 1,000°F (OR EVEN HIGHER WHEN YOU NEED IT!)

FEEDWATER HEATERS WITH YUBA'S EXCLUSIVE MULTILOK CLOSURE are capable in basic design of operating at the extreme pressures and temperatures required more and more by the power industry.

The Multilok Closure, a Yuba exclusive, is one of the important reasons why these units operate so efficiently and safely in the 4,000 PSI, 1,000° F range. And Yuba is prepared to produce units to handle even higher pressures and temperatures when needed. A pioneer in all-welded design, Yuba offers both all-welded and bolted construction – a complete and versatile line of feedwater heaters tor high and low ranges, for every type of job. When space is a critical factor, as many as three low pressure stages can be combined in a single shell for a highly compact unit.

You'll want to discuss both design requirements and costs with Yuba heat transfer engineers during plant planning stages. The scope of Yuba designs will offer the best solution to your particular problem.

Other Yuba products for steam power plants include condensers, evaporators, expansion joints, tanks, bridge and gantry cranes, structural steel erection, and scores of other items.

YUBA

specialists in power plant equipment

YUBA HEAT TRANSFER CORPORATION

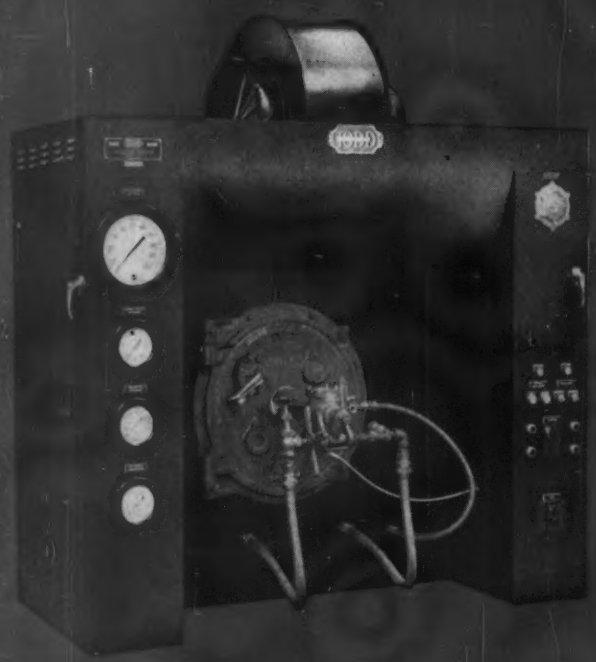
Tulsa, Oklahoma
Plants in Tulsa and Honesdale, Pa.

YUBA CONSOLIDATED INDUSTRIES, INC.

Sales Offices in Principal Cities

For more facts circle 253 on Reader Service card, p 99

UNIVERSALLY PROVEN AND ACCEPTED



TODD "SAV-PAC"

FORCED DRAFT – REGISTER TYPE
PACKAGED COMBUSTION SYSTEM

FULLY AUTOMATIC OR SEMI-AUTOMATIC . . . manufactured in a wide variety of sizes and models, arranged for firing steam boilers and high temperature hot water generators. Maximum burner output 135 million BTU per hour. Combustion efficiency 100%, no carbon residue . . . 5% to 10% excess air operation.

"SAV-PAC" is built for trouble-free performance using all grades of fuel oils, gaseous fuels or combinations of both. Self-contained unit includes hinged register type burner for simplified maintenance and auxiliary boiler entry. Available with axial flow or centrifugal forced draft fans (electric motor or steam turbine driven) of standard recognized manufacture. Piping and wiring enclosed in separate integrally mounted cabinets; combustion controls, either metering or positioning type, with pneumatic or electric operation.

ALSO AVAILABLE WITH TODD "ROTO-PAC" FULLY AUTOMATIC FORCED DRAFT ROTARY BURNER SYSTEM.

WRITE FOR COMPLETE DETAILS AND SPECIFICATIONS

TODD PRODUCTS

A DIVISION OF TODD SHIPYARDS CORPORATION

Sales and Engineering: Columbia and Halleck Sts., Brooklyn 31, N. Y.

Manufacturing: Green's Bayou, Houston, Texas

Free literature

Begins on page 99A

bulletin WE-1. Aeroil Products Company, Inc

Electric systems

• Generation and transformation

164 **Power-supply center** 4-p catalog 2469 contains weights, dimensions, accessory list and prices. Applications range from 750 to 2500 kva, 15 kv and below. Pennsylvania Transformer Div, McGraw-Edison Company

165 **Electric set's features** are highlighted in 6-p publication BU-752. Specifications of 20- to 35-kw units are given. Allis-Chalmers Manufacturing Company

166 **Dry type transformer** buying info is given in 8-p booklet. Atlantic Transformer Company

167 **Condenser bushings** are interchangeable between transformers and circuit breakers. 10-p booklet MB-1928 on 23- to 196/230-kv bushings is from Westinghouse Electric Corp

• Distribution and protection

168 **Silicone rubber** for wire and cable insulation is topic of 8-p booklet S-4 offered by General Electric Company

169 **Flexible conduit** info for specifying — diameters, weights — is found in 4-p folder S-544. Anaconda Metal Hose Div, Anaconda American Brass Co

170 **Plastic conduit and fittings**—underground and PVC for electric wires and cables—are topic of two bulletins. Specifications include installation info. Consolidated Pipe Company

171 **Electric conduit:** subject of 8-p catalog. How it maintains resistance to shock, water, acids, alkalies, corrosion and electrolytic action is explained. Bermico Div, Brown Company

172 **300-v 10-amp relays** are designed to cut control-panel space requirements by eliminating wiring trough. 12-p brochure GEA-7329 tells how to order. General Electric Company

173 **H-v power-fuse** selection and application is dealt with in 16-p guide 36-660. Refill, drop-out and current-limiting fuses are described. Westinghouse Electric Corp

174 **Oil circuit breakers** for 14.4- and 23-kv service are detailed in 8-p bulletin 71B9705. Units' features: cross-blast interrupters, solenoid or stored-energy operator. Allis-Chalmers Manufacturing Company

continued

Compact Packaged Air Preheater being unloaded for installation on new 100,000 lb/hr boiler at Hoffmann-La Roche's Nutley, N. J. headquarters. In operation, it will increase the temperature of the combustion air 375°F—thereby increasing boiler efficiency by approximately 8%.

PACKAGED AIR PREHEATER

WILL RECOVER 330°F FROM NEW BOILER FOR HOFFMANN-LA ROCHE INCORPORATED

Hoffmann-La Roche, one of the leading producers of pharmaceuticals, vitamins and aromatic chemicals, specified a Ljungstrom Packaged Air Preheater for their new boiler for three reasons: 1) This compact, preassembled unit is ready to run as soon as it's connected to the power line and ducts—no extra installation or erection costs; 2) The unit occupies only about 450 cubic feet of space but will cut boiler exhaust temperatures from 680°F to 330°F—for about 8% saving in fuel; 3) Savings in fuel alone—roughly 1% for every 40°F drop in exit gas temperature—can pay for the unit in two short years!

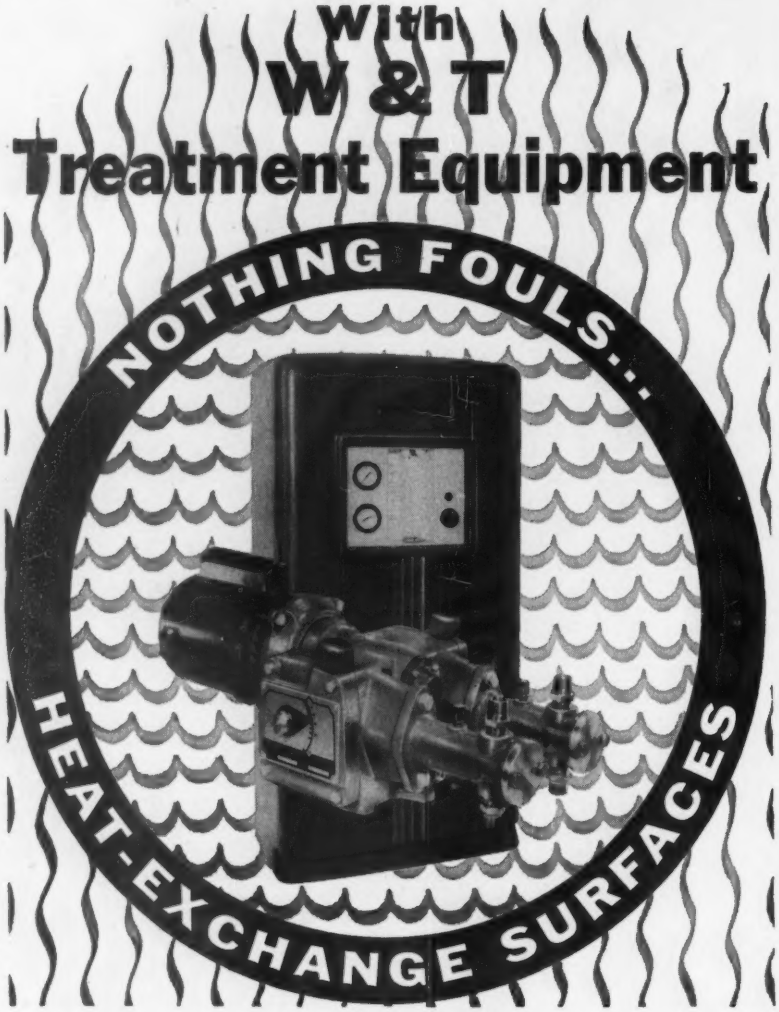
Packaged Ljungstroms are available in sizes for use on boilers in the 25,000 to 250,000 lb/hr range—can give you these same fuel saving advantages. For full information, write today for our 14-page Packaged Air Preheater booklet.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

For more facts circle 255 on Reader Service card, p 99

With W & T Treatment Equipment



Now you can take the sting out of cooling-water contaminants, solve treatment problems with chlorinators and pumps by Wallace & Tiernan.

For biological control there's intermittent desliming.

W&T chlorination kills slime and spores, never lets growth affect heat-exchange capacity. Job-proportioned V-notch Chlorinators feed up to 8,000 lbs. of chlorine per day. Treatment is efficient and economical. You get reliable control. Heat-exchange surfaces stay slime-free.

For pH and corrosion control there's chemical feeding.

The Wallace & Tiernan Series 100 Pump feeds chromates or acids at rates of up to 50 gph or boiler-treatment chemicals against pressures up to 1200 psi. The pump's unitized construction means lifelong accuracy, reduced maintenance. Choose one or two liquid ends, with individual stroke adjustment, to double capacity or feed two chemicals simultaneously. Where high pressures are not a problem, W&T Diaphragm Pumps also give reliable feeding of 1 to 500 gpd. Heat-exchange surfaces stay corrosion-free.

With Wallace & Tiernan Chlorinators and Pumps you keep condenser tubes clean and sound, assure heat-exchange efficiency.

For more information, write Dept. S-149.76.

WALLACE & TIERNAN INC.
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

Free literature

175 **Electric-insulation tubing** and sleeving in A to H classes are subject of 12-p bulletin. Temperature ranges, chemical resistance and strength are charted. Irvington Div, Minnesota Mining and Manufacturing Co

176 **Outdoor disconnecting switches,** 7.2 to 345 kv, are illustrated in 20-p catalog 36-250. Types: single and double throw, single and multipole with manual or electric operating mechanisms. Westinghouse Electric Corp

177 **L-v power capacitor** 4-p booklet GEA-7198 gives system case studies. Models are rated from 2½ to 25 kvar at 230, 460 and 575 v. General Electric Company

178 **Dielectric compound** in ribbon and bulk form is available for insulation and sealing. Bulletin EL-65A contains properties table. Johns-Manville

179 **Stationary housed switch** and fuse equipment rated 2.4 to 15 kv is topic of 4-p folder GEA-7186. General Electric Company

180 **Post insulator** bulletin TIA-184 gives info on the stacking station insulators rated from 550 to 1470 kv in its 4 pp. General Electric Company

181 **Transfer switches,** contactors and timers are summarized in 4-p circular A-17. Zenith Electric Company

182 **Portable load boxes** in 0.1- to 5-kva ratings, test units for circuit breakers rated 1 to 22.5 kva and insulation-resistance testers are subjects of three bulletins: 8-p SB-LB-1, 16-p SB-CB-1 and 4-p SB-IRT-1. Multi-Amp Div, Multi-Amp Electronic Corp

183 **Transfer switches,** 1200, 1600 and 2000 amp, are featured in data sheet 906-105. Automatic Switch Co

184 **Ac and dc voltmeters** and ammeters are portable, but they convert to panel or switchboard mounting without adapters. Spec sheet 06-209 is from Daystrom, Inc, Weston Instruments Div

185 **Molded-case breaker** 4-p folder 5000-1B illustrates new frame designations available. I-T-E Circuit Breaker Company

• **Application**

186 **Encapsulation** for motor-winding protection is topic of 8-p brochure F-2034. Results of tests show chemical-fume, heat, cold and electric-surge protection. U.S. Electrical Motors Inc

187 **Fluorescent luminaires** 10-p publication B-8235 points out style

Begins on page 99A

combinations offered by maker. Westinghouse Electric Corp

188 **Wound-rotor motors** range in size from 1 to 30 hp. 4-p bulletin 104 is available from Louis Allis Co

189 **Ac integral-hp motors** drive compressors, pumps, air conditioners and refrigerators. 6-p bulletin L-331 gives details. Kingston-Conley, Inc

190 **Radiant-lamp** 16-p catalog pinpoints indoor and outdoor applications. 116 types of hard-glass incandescent and mercury-reflector lamps are featured. Radiant Lamp Corp

Steam and hot-water systems

191 **Hot-water heating** equipment 16-p catalog 1551B introduces ASME expansion tank, steam and water converters. Performance curves, pressure-drop tables and installation diagrams are found in revised booklet from Dunham-Bush, Inc

192 **Steam superheater** is separately fired, completely packaged and rated 1-million Btu per hr. Spec sheet 4038 is from Vapor Heating Corp

193 **Steam trap** has floating disk. 4-p folder 900A explains unit's operation via diagrams. The Clark Manufacturing Co

194 **"Steam or hot water** for power heat or process" is title of 18-p booklet AA-2-7-60-10M on maker's steam generator. Cutaways, flowmeter chart and unit's ratings at full load are included. Ames Iron Works Inc

• Heaters and burners

195 **Fuel-oil heaters** are used on suction side of pump to heat viscous fluids. 8-p bulletin 200 describes two types—one installs with open end extending into tank, other mounts outside tank in the pipeline. Brown Fintube Company

196 **Fuel-burning systems** fire full range automatically with 5-to-1 turndown. Bulletin 1270 is offered by Orr & Sembower, Inc

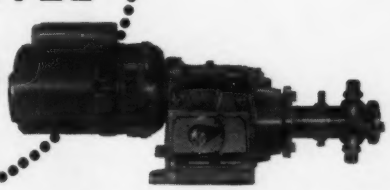
• Materials handling

197 **Conditioners**—500 lb to 150 ton capacity for bulk dry-material handling and 500 to 5000 lb per hr capacity for applying liquids to solids—are detailed in bulletins 5002-2 and 5002-3. Johnson-March Corp

NOW, GET

BIG PUMP

FEATURES



IN A SMALL PUMP

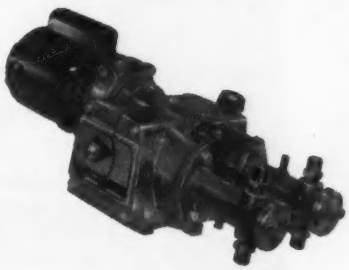
The New W&T Series 100

The Wallace & Tiernan Series 100 Metering Pump borrowed its design from W&T's Heavy Duty Pumps. Big-pump features are retained. Only size is scaled down for jobs like boiler-feed-water treatment.

The Series 100 Pump is one enclosed unit. There are no exposed moving parts. Motor and drive transmit thrust in a straight line. Pumping forces are absorbed by the heavy gear case. There are no rocker arms, no base-plate loads to twist components out of alignment.

Spring-loaded stuffing box assures proper pressure on the packing, prevents over-tightening, automatically adjusts for wear. Packing is easily replaced.

Stroke length is adjusted over a 10 to 1 range while the pump is running. Even in the double simplex, each liquid end is individually adjusted.



The Series 100 Pump delivers 3.2 gph vs 1200 psi, 50 gph vs 100 psi, repeatable within ±1%. You get big-pump performance at a small- capacity price.

For more information, write Dept. L-10.76.

WALLACE & TIERNAN INC.

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

Protect steel stacks with corrosion-resistant concrete

Corrosion-resistant concrete linings, made with LUMNITE calcium-aluminate cement and suitable aggregate, will protect stacks and breechings from the corrosive action of condensate.

When expanded shale aggregate is used, these linings also provide vital insulation. This keeps stack gases hot and helps maintain better draft for greater operating efficiency. The steel shell will stay cooler, too, extending the life of exterior paint. And these monolithic concrete linings have a lower unit weight, which reduces the dead load on the supporting structure.

Whether gunited or plastered, installation is easy and economical, with concrete reaching service strength in 24 hours. For even greater convenience, manufacturers of refractories offer castables bonded with LUMNITE cement – packaged mixtures ready for use with just the addition of water.

For more information, write Universal Atlas Cement, 100 Park Avenue, New York 17, N. Y.

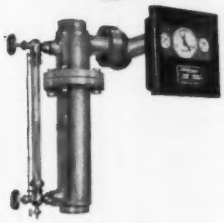
"USS," "Atlas" and "Lumnite" are registered trademarks L-197

INSTALLATION: Elrama Station, Duquesne Light Company, Pittsburgh, Pa.

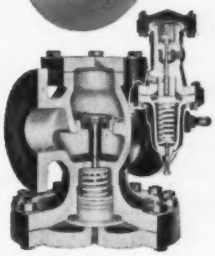
USS **Universal Atlas Cement**
Division of
United States Steel

Offices: Albany · Birmingham · Boston · Chicago · Dayton · Kansas City · Milwaukee · Minneapolis · New York · Philadelphia · Pittsburgh · St Louis · Waco

SPLIT-BODY VALVES



LEVEL CONTROLLERS



PRESSURE REGULATORS

DIAPHRAGM CONTROL VALVES

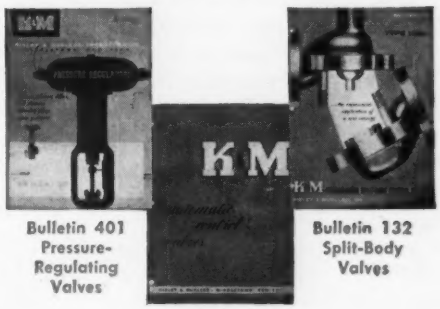
KEEP A FIRM HAND ON FLUID CONTROL WITH K&M VALVES ALL ALONG THE LINE

From the complete display on the K & M shelf, you can select the best type of valve for every control job in the process line. You can, in fact, standardize entirely on K&M. That means simplified specification, ordering, maintenance.

Especially maintenance. K & M engineers have put consistent design emphasis on field interchangeability of components. In a pinch, you can "borrow" an inner valve or a topworks assembly from a pressure regulator for use with a diaphragm motor valve. That's what we mean by interchangeability.

And because the K & M line is so diverse and inclusive, our field representatives are free to make unbiased suggestions on the type of valve best suited to your requirements. That can often mean substantial dollar savings all along the process line.

THREE TECHNICAL BULLETINS GIVE THE IMPORTANT FACTS AND FIGURES. THEY'RE YOURS FOR THE ASKING.



Bulletin 401 Pressure-Regulating Valves

Bulletin 132 Split-Body Valves

Bulletin CV53 Standard Diaphragm-Operated Control Valves

K&M

diaphragm control valves

KIELEY & MUELLER, INCORPORATED

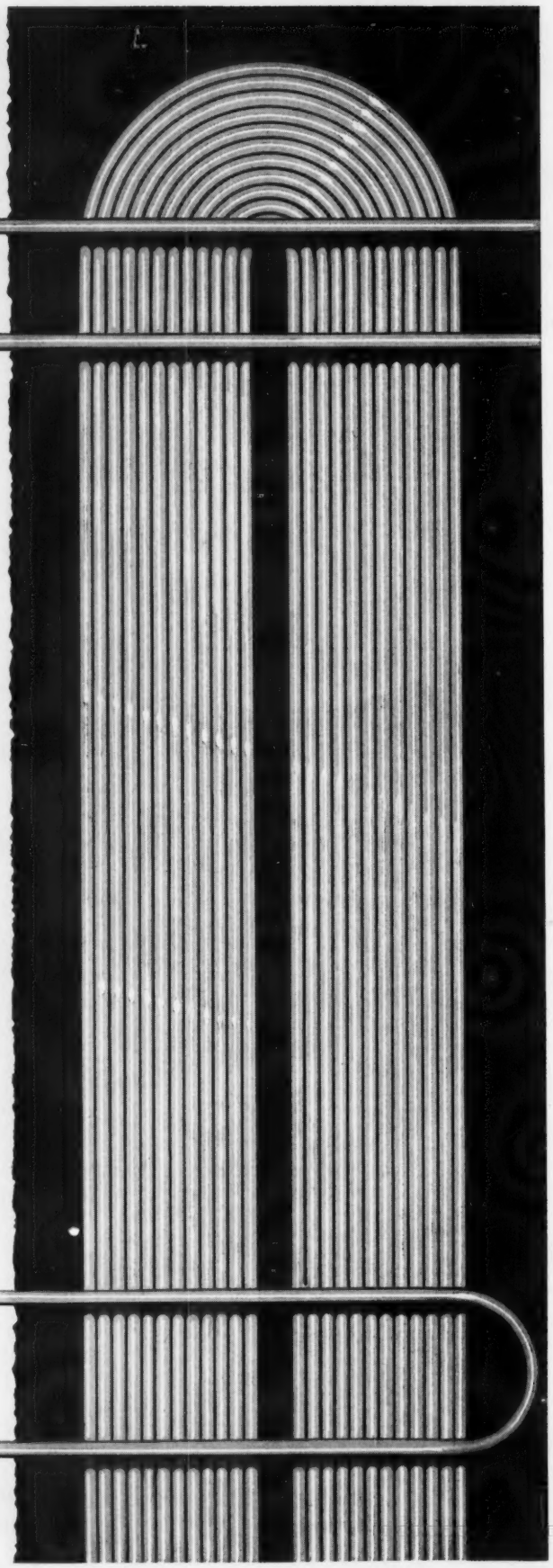
Our 79th Year

Oldest Pressure and Level Control Valve Manufacturer
64 Genung Street, Middletown, New York

K.A. 1721

For more facts circle 258 on Reader Service card, p 99

NEW FEEDWATER HEATER TUBE



provides high strength ... at lower cost

ANACONDA CUPRO NICKEL, 30%-707 provides important money-saving advantages over generally used feedwater heater tube alloys. Approved for condenser and heat exchanger use by the ASME Boiler & Pressure Vessel Code Committee, it offers highly desirable properties for power plant feedwater heaters . . . at lower initial cost.

A point-by-point comparison of mechanical properties is detailed in our Publication B-45.

Of course, this high-strength copper-nickel-iron tube alloy is only one of the many Anaconda alloys available for various types of heat exchangers. These include arsenical admiralty, red brass, 10% and 30% cupro nickels, phosphorized coppers, and Anaconda's own Ambraloys, Ambronze, and Everdur®.

For the complete story, ask your nearest Anaconda technical representative, or send for our 44-page Publication B-2 and Cupro Nickel, 30%-707 Publication B-45. Address: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 61-920

CUPRO NICKEL, 30%-707
Weldable
High Strength
Corrosion Resistant
Stress-corrosion Resistant

ANACONDA®
AMERICAN BRASS COMPANY

Maintenance and Steam Traps

. . . there's a relationship that goes far beyond trap maintenance alone

Good traps and good trapping have a greater effect on your maintenance costs than does trap maintenance itself. By that we mean that the right traps, properly selected and installed, and with the benefits of a preventive maintenance program, will save far more maintenance dollars than they will cost.

Under the pressure of spiralling maintenance costs, this thought becomes mighty important. Let's take a look at what it involves:

Proper Selection of Steam Traps

1. Be sure it's the right type of trap.

2. Be sure it's sized right and is for the correct operating pressure.

3. Be sure it's first rate in design and construction.

Proper Installation of Steam Traps

1. Install them so they are accessible for inspection and maintenance.

2. Install a test valve.

3. Use a union or unions.

4. Use a shutoff valve or valves.

5. Use a strainer ahead of the trap if dirt conditions are bad.

6. Use a by-pass only where continuity of service is imperative.

7. Standardize inlet and outlet connections.

Preventive Maintenance Program

1. Test trap regularly for proper operation. (Trap size, operating pressure and importance determine frequency.)

2. Inspect internal mechanism at least once a year.

You Get Indirect Benefits As Well

The direct benefits of the plan outlined are pretty obvious — good traps, properly selected, require less maintenance . . . testing and inspection prevents troubles that lead to maintenance.

However, this plan provides indirect benefits which reduce maintenance in other parts of the plant as well:

Good traps save steam and reduce the load (and consequently maintenance) on fuel handling and burning equipment and on ash handling equipment.

Good traps protect the system by eliminating water hammer and preventing the damage it can do.

Good traps discharge carbon dioxide before it can go into solution to form corrosive carbonic acid —less corrosion, less maintenance.

Good traps increase production to reduce the length of time equipment must operate or reduce the amount of equipment needed . . . either way maintenance is reduced.

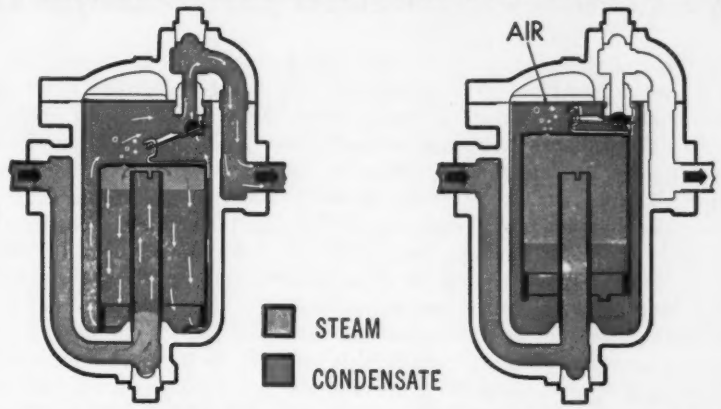
How to Go About It (The Sales Pitch)

We admit we're prejudiced, but we don't think there is any better way to select steam traps than with the help of the 44 page Armstrong Steam Trap Book. Here in a single source is specific data on the selection and sizing of traps, how to install them for best results, and how to maintain them most economically.

The Steam Trap Book will also give you full information on the design and construction of Armstrong Inverted Bucket Steam Traps that offer these important maintenance-reducing advantages:

1. Armstrong Traps are dependable.

HERE'S THE STEAM TRAP DESIGN THAT CAN REDUCE YOUR MAINTENANCE PROBLEMS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

2. Armstrong Traps require no adjustments — go from full load to zero load automatically.

3. Armstrong Traps are self-scrubbing—ordinary dirt conditions can't hurt them.

4. Armstrong Traps have long-life parts — valve and seat are heat treated chrome steel — lever assembly and bucket are stainless steel.

5. Armstrong Traps have water sealed valves to minimize wire drawing and erosion.

Ask for your copy of the Steam Trap Book—there is no obligation. Then test Armstrong Trapping. If you are not completely satisfied with the results, you can return the traps for a full refund of the purchase price. You can't lose much that way. Call your local Armstrong Representative or Distributor, or write

Armstrong Machine Works
8124 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

See Our Catalog in Sweet's Plant Engineering File

For more facts circle 262 on Reader Service card, p 99

Plant equipment news... Your

For more data on these developments, circle key numbers on Reader Service card, p 99

Expand existing water-treatment plants

1 • Water-clarification process boosts capacity of existing plants, saving 10 to 15% on installed cost of a new plant, maker claims. Chemical requirements drop—instead of developing a blanket of settleable floc, process depends only on individual particle to be removed. Majority of this is taken out in the separation beds; entire depth of bed holds suspended matter. Coagulant control center constantly monitors the process and bed construction. Operator sets control for desired water quality and is immediately alerted if raw water changes.

If you're building a new plant, fast flow rates hold construction costs down—rates through beds range up to 8 gal per sq ft per min compared to conventional 2-to-3 gal per sq ft per min of rapid sand filters.—MicroFLOC Corp

Analyzer keeps tabs on water hardness

2 • Automatic colorimetric analyzer takes a sample of plant's water supply every 3-to-6 min and electronically analyzes hardness present in such minute quantities as 0-to-3 ppm. Water-softening equipment and analyzer work side by side, analyzer continuously checking equipment's performance. Some plants use analyzers to obtain 400 or more samples a day as insurance against accidental breakthrough of hardness in their water supply — whereas manual laboratory analysis by a plant chemist would give them only a few samples a day.

Besides handling universal problem of hardness in key industries, analyzer is capable of coping with less common analyses: phosphate, residual chlorine, caustic, free acidity and fluoride.—Milton Roy Company

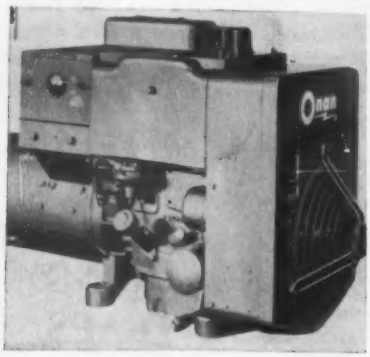
Gas-fired unit heater comes in 11 capacities

3 • Economy propeller-fan gas-fired unit heater is designed for use where basic thermostatically controlled heat is needed. Available in capacities ranging from 25,000- to 300,000-Btu output, it is produced in two models: one for 115-v operation and the other equipped with a 24-v transformer and fan control for l-v use. All controls are enclosed within the heater cabinet. Unit is standardly equipped with an aluminized-steel heat exchanger; stainless-steel exchanger is optional.—Reznor Manufacturing Company

Water heater is packaged

4 • Tube-bundle electric storage-water heater is completely packaged—electric and water connections put it into operation. Available either vertical or horizontal, it has a capacity range from 284 to 1300 gal, with recovery capacities from 41 to 410 gph. Working pressures are 100, 125 or 150 psi. Immersion elements for 208, 220 or 240 v operate about 10% below voltage capacity. Automatic water heaters operate close to the 100% efficiency mark, manufacturer states.—Patterson-Kelley Co, Inc

I-c engines in new series are look-alikes



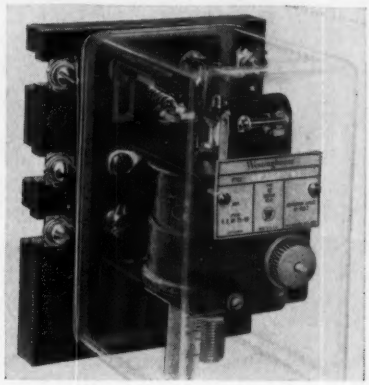
5 • Series of 12 i-c engines with overhead valves and matching generators provide from 6 to 30 hp and 3000 through 15,000 w. Air-cooled and water-cooled gasoline and diesel models in 1, 2 and 4 cylinders look like the version here, a 5000-w air-cooled 2-cylinder generator. They have much in common—parts and tooling are standardized for interchangeability. Vary accessories and unit takes any of the common fuels.—Onan, Div of Studebaker-Packard

Computer reveals faults

6 • Deterioration in condenser performance often cannot be detected in time to prevent forced outage. Analog computer plots predicted condenser performance curves to determine expected backpressure for existing cooling-water inlet temperature and condensate flow. Actual pressure is measured and expected pressure subtracted from it, showing any deviation. Unit is sensitive to changes of 0.1-in. Hg, consists of four plug-in recorder servos.—Bailey Meter Company

information center for new products and materials

Instantaneous relays offer 1-cycle operation

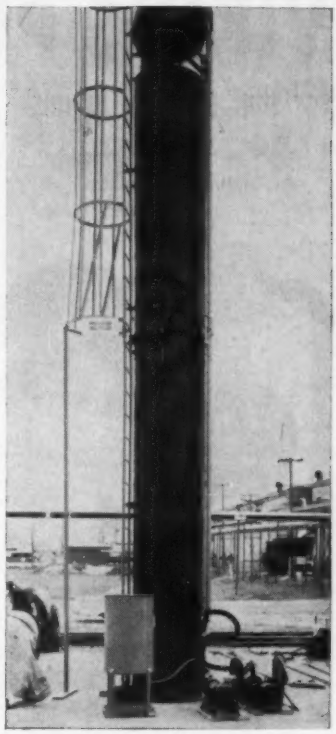


7 • Front-connected relays are fault detectors—supervise main protective relays and guard motors against high-current or l-v damage under abnormal conditions. Supplied for either dc, or 50- or 60-cycle-ac service, some adapt to dc and 25- to 60-cycle ac without coil changeover. You can mount these flat. Instantaneous-plunger elements give 1-cycle operation at two times pickup on ac. Pickup adjusts over entire relay range and sets for specific pickup or dropout values.—Westinghouse Electric Corp

Windings are now aluminum

8 • As POWER predicted six years ago (Nov 1955, pp 95-7), aluminum strip in transformer windings has made its appearance. This distribution transformer's l-v windings are made with aluminum-strip conductor the full width of the coil. Core design —stress-free assembly in rectangular configuration — makes for optimum magnetic balance between two windings. This enables units to withstand short-circuit currents of more than 50 times rated current, so they say.—H K Porter Company, Inc

Test before you buy →



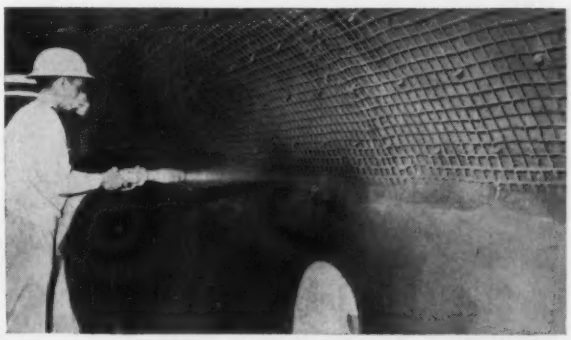
9 • Pilot plant analyzes wastes and tests effectiveness of indicated treatment before you invest in full-scale equipment. It operates on a trickling-filter principle, provides large surface areas for active biological slimes to adhere to. This is said to promote oxidation of liquid wastes.

Heart of plant is a plastic packing material fabricated from Saran in individual corrugated sheets. Assembled, it forms a cubic module for maximum aeration efficiency.

Plant is shipped completely assembled—goes as a tubular steel structure with rotary distributor, pumps, nutrient feeders and accessories. Customer need only furnish inlet and effluent piping plus an 8-ft-sq concrete foundation pad. Plant may be purchased or leased for basic 6-month period and then rented monthly.—Dow Industrial Service, Div of The Dow Chemical Company

Refractory can be wet- or dry-gunned

10 • Castable refractory for pneumatic wet- or dry-gun placement produces a monolithic body said to resist abrasion and thermal shock. Use it to line ashpits, stacks, dust collectors and boiler furnaces. A high-alumina cement provides strong hydraulic bond—base is graded, highly calcined. Predampening with one quart of water per bag reduces dust when dry-gunning. Wet-gun applications take about six quarts per bag. Temperature for use: 2500 F. After heating at 2400 F, refractory has a cold-crushing strength of 4200 psi.—The Babcock & Wilcox Co



For more data on these developments, circle key numbers on Reader Service card, p 99

HIGH SPEED-HEAVY DUTY

3 to 30 G.P.M.

VIKING PUMPS

for thin or thick liquids

- fuel oils
- solvents
- lube oils
- alcohol
- other liquids

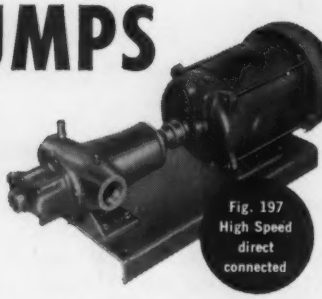


Fig. 197 High Speed direct connected

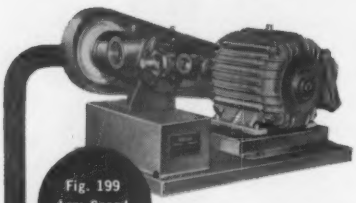


Fig. 199 Low Speed V-belt drive

Here you are—really rugged pumps—designed for high speed and heavy duty, giving smooth, positive delivery of thin or thick fuel and lube oil, solvents, alcohols and other liquids. They're built for continuous or intermittent duty in such applications as filtration, circulation, transferring and booster service.

Capacities range from 3 to 30 G.P.M. Speeds from 600 to 1750 R.P.M. Temperature range from –40 to 225 degrees F., viscosity range from 30 to 10,000 S.S.U. 100 P.S.I. for non-lubricating liquids. 200 P.S.I. for lubricating liquids.

Install these new heavy-duty Vikings and enjoy the best pumping service you've ever known!

For additional information, ask for Bulletin SP-522 W

50 YEARS

VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, It's "Roto-King" Pumps

See Our Catalog in Sweet's Industrial Construction and Plant Engineers File

For more facts circle 263 on Reader Service card, p 99

The World's Fastest Tube Bending Service

Most complete stock of boiler tubing anywhere

•

Bent Tubes fast for any make or size of boiler

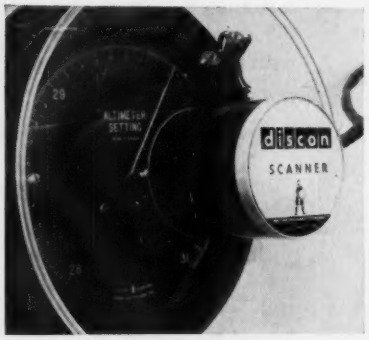
BOILER TUBE COMPANY OF AMERICA

McKEES ROCKS, PA. (Pittsburgh District) Federal 1-7750

For more facts circle 264 on Reader Service card, p 99

Equipment news

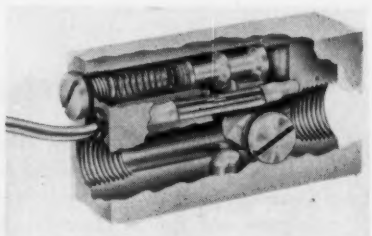
Begins on page 114



Digital scanner-converter

20 • Photoelectric unit scans dial and pointer instruments, while the digital converter provides remote digital output with zero load on signal source. Reading pressure gages, flowmeters, thermometers, electric meters, liquid-level gages are some applications; outputs will operate digital displays, data printers, tape or card punches. The unit bridges existing instrument dial—any size from 3- to 20-in. dia—and mounts outside the instrument flange. There's no physical connection to shaft or pointer of instrument, therefore no friction or inertia loading on sensing element. Another application: as a deviation alarm.—MacLeod Instrument Corp

Just circle key numbers on the Reader Service card, page 99, to get complete product story



Adjustable flow switch

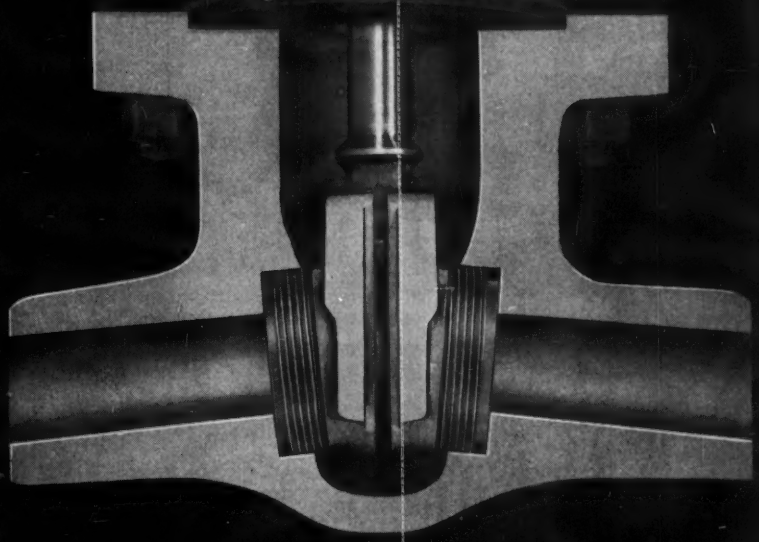
34 • Compact, simply designed switch adjusts in the field to detect variations in flow rate of fluids or gases. Displacement of a magnet-equipped shuttle actuates hermetically sealed switch contacts; they in turn

circle 265 on Reader Service card, p 99 ➤

POSITIVE-LY NEW!!

CHAPMAN BI-VALVES

Chapman's new Bi-Valves are designed around a different swivel disc principle which guarantees automatic self-seating and positive shutoff on both upstream and downstream faces. Bi-Valves offer economy and performance unobtainable up to now.



EXCLUSIVE BI-VALVE FEATURES:

1. Automatic positive seating, absolute shutoff
2. Interchangeable with solid wedges
3. Reversible for wear compensation
4. Disks changed without removing valve from line
5. Standby valves eliminated
6. Galling and seizing on seating surfaces minimized
7. Reduced spindle thrust
8. Replaces double valving under certain conditions
9. Unaffected by pipeline strains, temperature swings, welding heat or other loads induced by the pipeline
10. Will not stick when closed hot and opened cold
11. Maintenance time and cost drastically reduced
12. Available in sizes from 2" up, all pressure classes in steel at no increase in price

CHAPMAN BI-VALVES WILL REVOLUTIONIZE THE THINKING ON VALVES.
See your CHAPMAN Representative now, or send in the coupon for more details.

CHAPMAN VALVE

MANUFACTURING COMPANY ■ INDIAN ORCHARD, MASSACHUSETTS

The CHAPMAN VALVE MANUFACTURING COMPANY
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Let me hear more about Chapman BI-VALVES

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COMPANY _____

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Belmont Packings are the "Better Buy" Because...

① Most complete line * to choose from in finding the exact answers to your Sealing Problems. You won't be sold a "Just-as-good".

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Better Buy

BELMONT

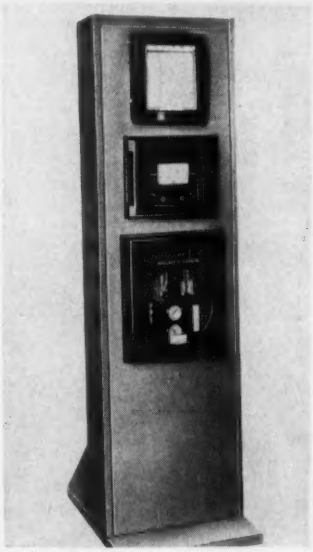
THE BELMONT PACKING & RUBBER COMPANY • PHILADELPHIA 37, PA.

For more facts circle 266 on Reader Service card, p 99

Equipment news

Begins on page 114

operate a remote warning light or visual or audio indicator. Externally adjustable actuation range: 0.1 to 10 gpm, 0.5 to 30 scfm.—The Gems Company, Inc



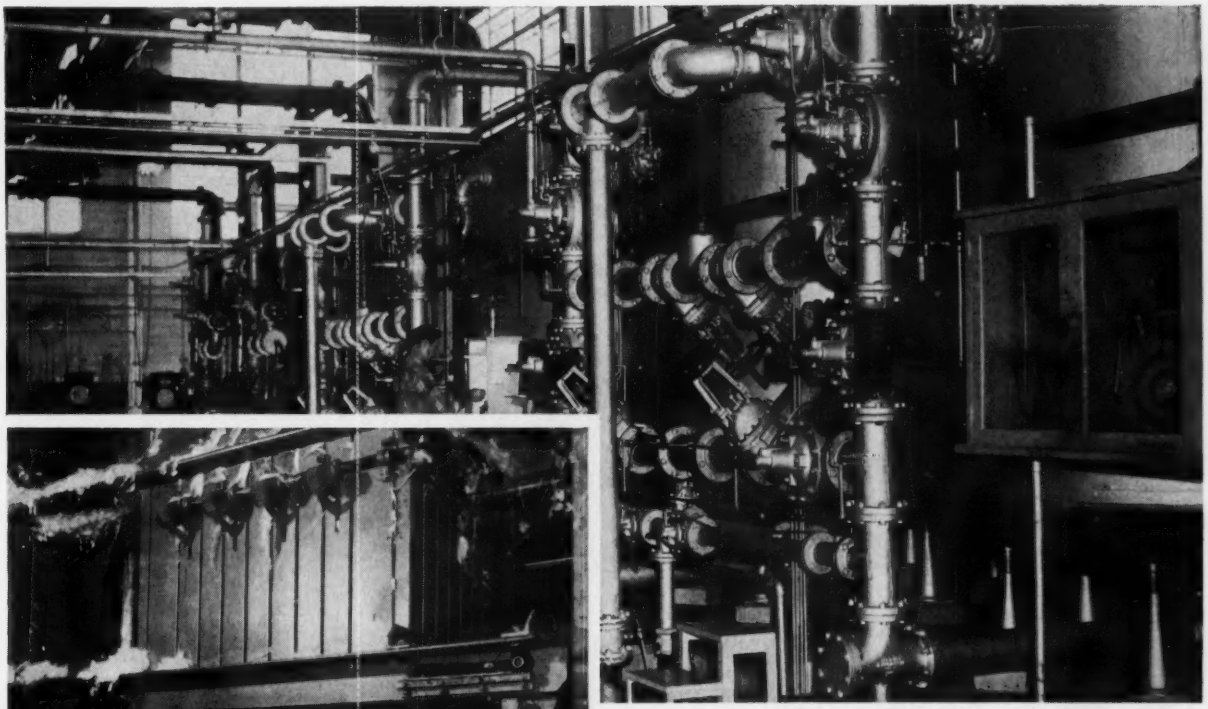
Dissolved-oxygen analyzer

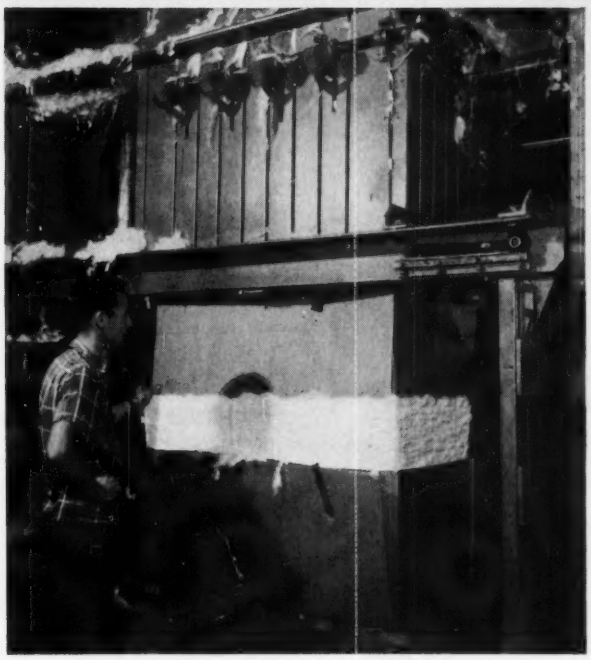
28 • Precision instrument continuously measures and records microquantities of dissolved oxygen in boiler water and other high-purity systems. The electrochemical analyzer acts direct. Its printed circuits promise compactness, reliability, easy maintenance. Readings are said to be accurate to ±5% of full scale—change of 0.1 ppb registers within 5 to 10 sec.—Wallace & Tiernan Inc

Just circle key numbers on the Reader Service card, page 99, to get complete product story

One-hand test meter squeezes into tight spots

46 • Lightweight pistol-shaped meter has revolving jaws. You insert them into cramped gutters and cable boxes at any angle; there's a trigger-operated probe light at meter's end so you can see what you're doing. Meter pointer's locking device holds





ABOVE: AMBERLITE® 200 is used in two softeners in this group. Here the durable polymeric structure of this resin successfully resists the action of "aggressive water" which shortens useful life of conventional ion exchange resins.

LEFT: Baling of rayon staple fiber at Lowland, Tenn., plant of American Enka Corporation.

Enka rayon plant solves "Aggressive Water" problem with AMBERLITE 200

At the Lowland, Tenn., plant of American Enka Corporation, water for washing rayon staple fiber and yarn is breakpoint chlorinated to oxidize impurities. It enters softeners with 0.3 ppm residual chlorine. Trace metals present in the raw water act as oxidation catalysts and make the chlorine "aggressive" toward ion exchange resins. Useful life of conventional cation resins is shortened through decrosslinking which weakens the polymer structure, increases pressure drop, and promotes channeling.

When AMBERLITE 200 was installed in two of American Enka's ion exchange units, its revolutionary polymeric structure was the answer to "aggressive water". Wherever oxidation is a problem, AMBERLITE 200 gives longer resin life than conventional resins, and thus lowers operating cost.

AMBERLITE 200 also has excellent resistance to bead cracking from physical stresses.

For more information on AMBERLITE 200 performance under conditions that degrade conventional resins, write for our technical bulletins. Also ask for a 16-page booklet that shows how many different industries use AMBERLITE ion exchange resins for specific applications—boiler-water softening and deionizing, chemical processing, and many others.

ROHM & HAAS

PHILADELPHIA 5, PA.

AMBERLITE 200

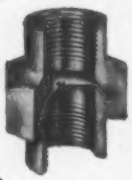
Catawissa PERFECT SEAL Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy
UNIONS

Available with screwed or socket weld ends. 3000-lb. sizes 1/8" to 3"; 6000-lb. sizes 1/8" to 2".



GASKETLESS
CUP-ORIFICE UNIONS

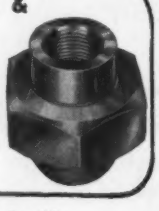
Choice of stainless or carbon steel cup-type plate. 3000-lb. service.

MALE & FEMALE UNIONS

With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

FULL STAINLESS & FULL ALLOY STEEL UNIONS

With screwed or socket weld ends. 3000-lb. and 8000-lb. service.



Write for Catalog 60
Showing the Complete Catawissa line of Perfect Seal Products

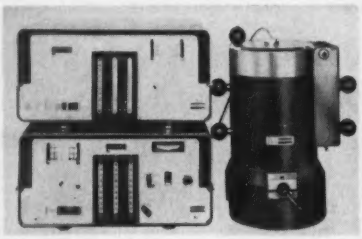
CATAWISSA VALVE & FITTINGS COMPANY
CATAWISSA, PENNA.

circle 268 on Reader Service card, p 99

Equipment news

Begins on page 114

the reading after instrument is removed from conductor you're testing. Meter has two voltage scales, four current and two ohmmeter ranges.—Federal Pacific Electric Co



Proportional system senses and counts radiation

44 • Single-detector proportional counting system senses and counts alpha and beta radiation independently and simultaneously. All-transistorized system is made up of a universal shield enclosing the gas-flow proportional counter-detector, right, and two decade scalers, left—one for the alphas and one for the betas. Price tag: $2495.—Nuclear Measurements Corp

Just circle key numbers on the Reader Service card, page 99, to get complete product story

Remote indicator

29 • Rugged sensor and remote indicator signal position of butterfly valves, dampers and other process-control equipment. Sensor comes in your choice of weatherproof or explosionproof enclosure, face or flange mounting. It's also available with one or two potentiometers or limit switches, to add control to its other functions.—Jordan Controls, Inc

Liquid-level transmitter

31 • This device combines mechanical-measuring accuracy with electronic-signaling efficiency, claims its maker. It transmits dc signals proportional to level variations and will

Checklist of helpful McGRAW-HILL BOOKS

GAS AND AIR COMPRESSION MACHINERY

Just Published. Provides practical help for determining size and performance of pneumatic machinery, planning the installation, etc. By L. F. Scheel, Consult. Engr.; asst. by A. K. Hegeman, Clark Bros. Co. 330 pp., 194 illus. and tables, $12.00

THEORY OF HYDRODYNAMIC LUBRICATION

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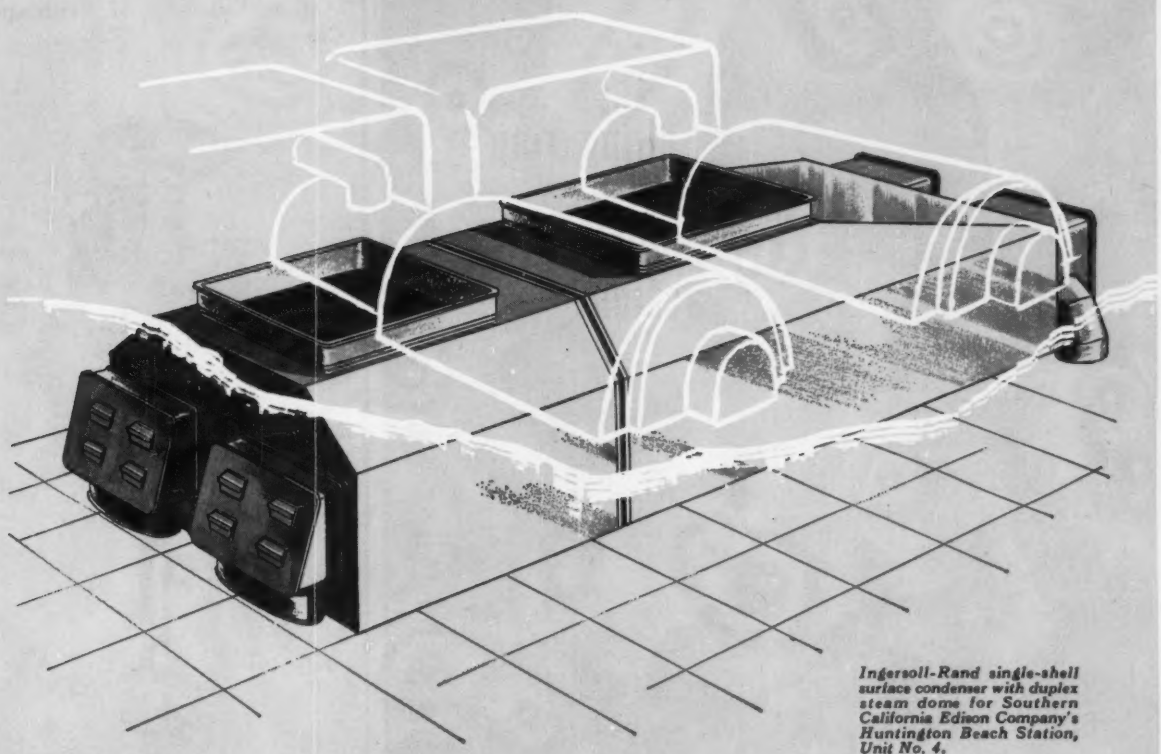
Adding new dimensions *to engineering*



Ingersoll-Rand single-shell surface condenser with duplex steam dome for Southern California Edison Company's Huntington Beach Station, Unit No. 4.

Here's a steam condenser that's LONG ON TUBES and SHORT ON HEIGHT

(It's the shape of things to come when capacity is high and head-room is low)

Here's a new way to package 105,000 sq feet of steam condensing surface. Many refer to it as our "Long John" design. It features 54 foot long tubes, has an overall length of 65 feet and requires *only 18 feet of headroom.* The offset duplex steam dome is specially engineered to optimize distribution of steam and provide for better overall turbine-condenser efficiency.

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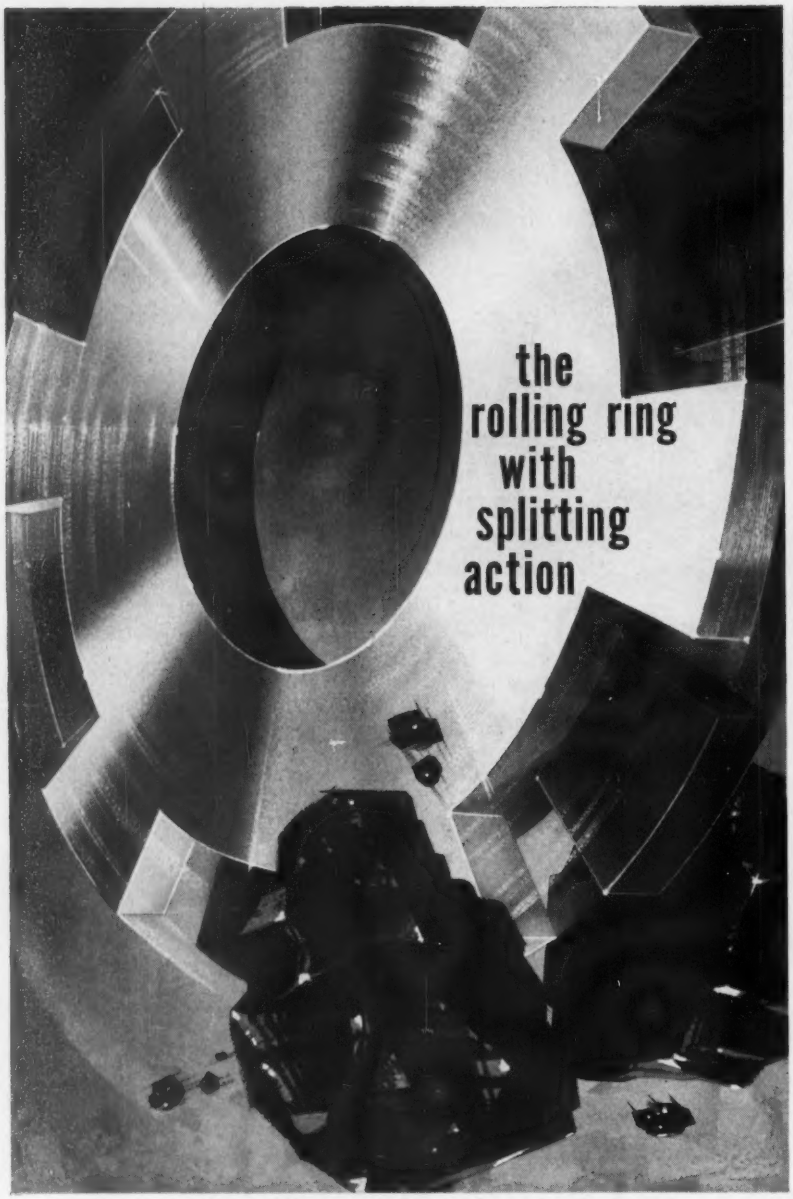
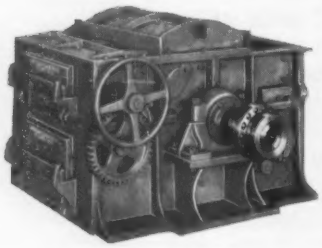


American's inside story of: uniform sizing/minimum fines/no oversize/rapid reduction/less power cost



American Coal Crushers don't actually crush coal—they split it, along the natural lines of cleavage. A series of rugged manganese steel shredder rings, each with many cutting edges, quickly and cleanly reduce the coal to uniform size lumps. Because of the splitting action... troublesome fines are drastically reduced. It's the proven, efficient method of coal reduction.

For complete information, write for bulletin on American AC Coal Crushers.

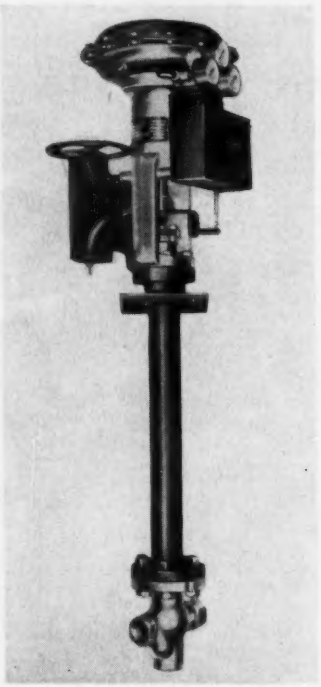
American PULVERIZER COMPANY
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS
1349 MACKLIND AVE. ST. LOUIS 10, MISSOURI

6130

Equipment news

Begins on page 114

adapt to any system that uses electronic indicators, recorders or controllers. Unit mounts left- or right-hand; you can reverse it in the field. —Mason-Neilan Div of Worthington Corporation



Cryogenic control valve

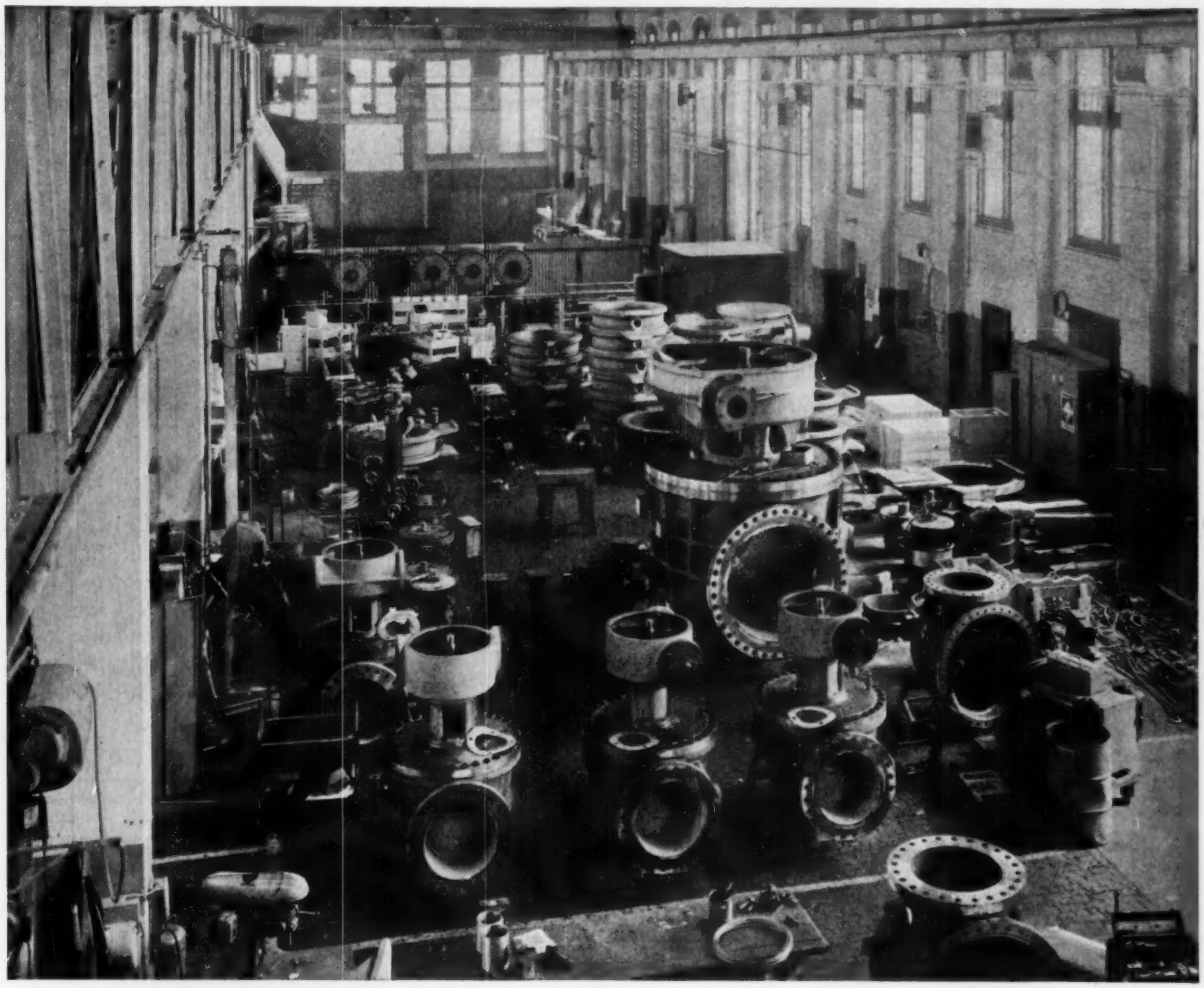
30 • Throttling control valve is a globe type, but it's said to close tight through wide temperature variations —cool-down, on-stream runs and defrost periods. Another special cryogenic feature: complete disassembly from top end—important when valve is embedded in heavy insulation or a cold box. Available in ½- to 4-in. bodies in bronze or aluminum, ½- to 2-in. stainless.—Leslie Co

Just circle key numbers on the Reader Service card, page 99, to get complete product story

Redesigned air dryer

25 • Revamped dryer for compressed-air systems places inlet and outlet connections directly opposite each other, so the unit fits easily into

ALLIS-CHALMERS



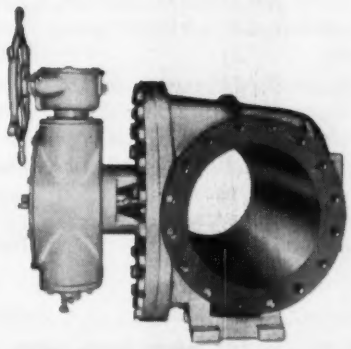
Another shipment of "habit-forming" valves

built for performance that always captures repeat customers!

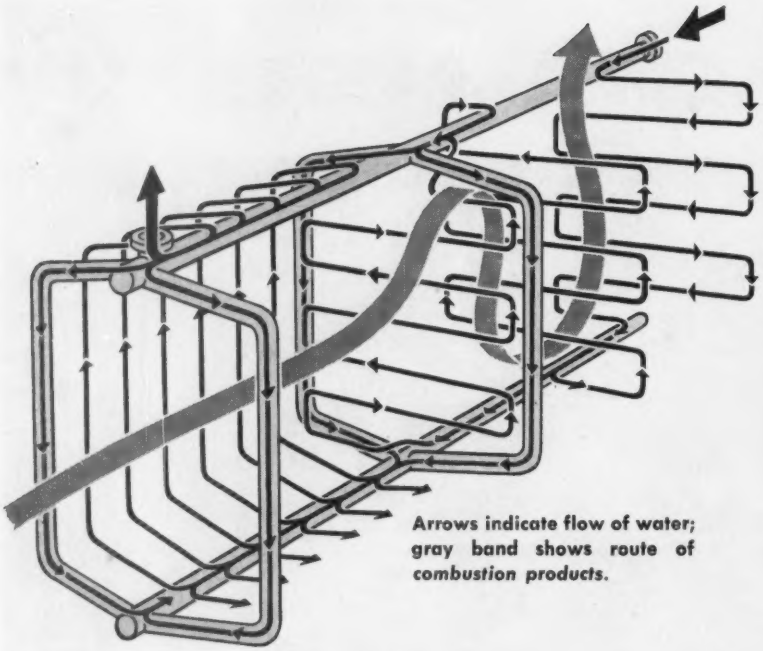
Here we see one small part of the latest shipment of Allis-Chalmers valves destined for a long-time customer. These units will augment hundreds of A-C valves already installed in the same western metropolitan water system, many of them tracing satisfactory service back a quarter of a century!

Shown are four 300-lb, 24-in. *Rotovalve* units (two motor-operated, two manual) . . . a 48-in. cast-steel *Rotovalve* for 300 psi (motor-operated) . . . and several butterfly valves of the 136 ordered (all rubber-seated, motor-operated, ranging in size from 12 to 48 inches).

Allis-Chalmers offers today's only complete, perpetual rotary-valve stocking program, assuring you fastest delivery, thanks to "off-the-shelf" availability. For help anytime, contact your nearby A-C valve representative, district office, or simply write to **Allis-Chalmers,** *Hydraulic Division, York, Pa.* A-1395



The ROTOVALVE is probably your best all-round buy in a valve. Wide open it has no more resistance to flow than a straight piece of pipe of equivalent length. Actually seats itself tighter with use. *Rotovalve* is an Allis-Chalmers trademark.



Arrows indicate flow of water; gray band shows route of combustion products.

Why BROS High Temperature Water Generators Offer You Efficiencies Never Before Available!

If you are interested in truly *efficient* space heating or in chemical processing which demands *precise control of temperatures*, it will pay you to investigate the BROS High Temperature Water Generator.

Water vs. steam. High temperature (300° to 450°) water offers you important advantages for heating. Depending on pressures and temperatures, water will store approximately 20 times as much heat as an equal volume of steam. The BROS HTW Generator shown above is especially economical for horizontal movement of large amounts of heat.

Factory-assembled. BROS HTW Generators are completely packaged units. They are efficient, reliable, easy-to-clean, and inexpensive-to-maintain.

The unusual efficiency is due to several features: counterflow of gas and water . . . all heating surfaces consist of tubes (no extended surfaces) . . . deep furnace design which provides long flame travel . . . super-effective insulation.

Combines gravity and forced circulation. Circulation with a BROS HTW Generator does not require orifices at entrance or exit of tube circuits in order to regulate and proportion the water flow. Instead, gravity circulation is used to augment forced circulation. This automatically provides uniform flow throughout radiant tube circuits and virtually eliminates possibility of damage due to pump or line failure.

No thermal shock. Even when return water is reintroduced at temperatures 200° lower than when it leaves, there's no risk of damage from thermal shock.

Capacities, pressures. These compact generators are available for temperatures between 300° and 450°F with corresponding saturated pressures from 70 to 425 psig. Capacities range from 2 million to 70 million btu per hour.

For illustrations, features, drawings, specifications and complete performance data, see your nearest BROS Representative . . . or write

POWER DIVISION

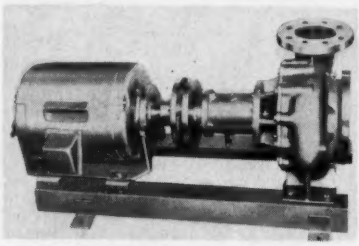
BROS Incorporated

1057 Tenth Avenue S. E., Minneapolis 14, Minnesota

Equipment news

Begins on page 114

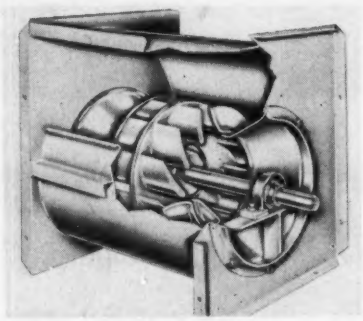
your piping system. This is a 2-stage mechanical-chemical dryer; its mechanical-separator section is said to work on a new flow principle.—General Welding & Fabricating Company



Centrifugal pump

27 • Pump force-feed-lubes sleeve bearings to stretch their life. Self-aligning coupling connects sleeve-bearing motor to pump. Pumps are designed for service in comfort-conditioning systems, at top capacity of 1000 gpm, heads to 80 ft.—Dunham-Bush, Inc

Just circle key numbers on the Reader Service card, page 99, to get complete product story

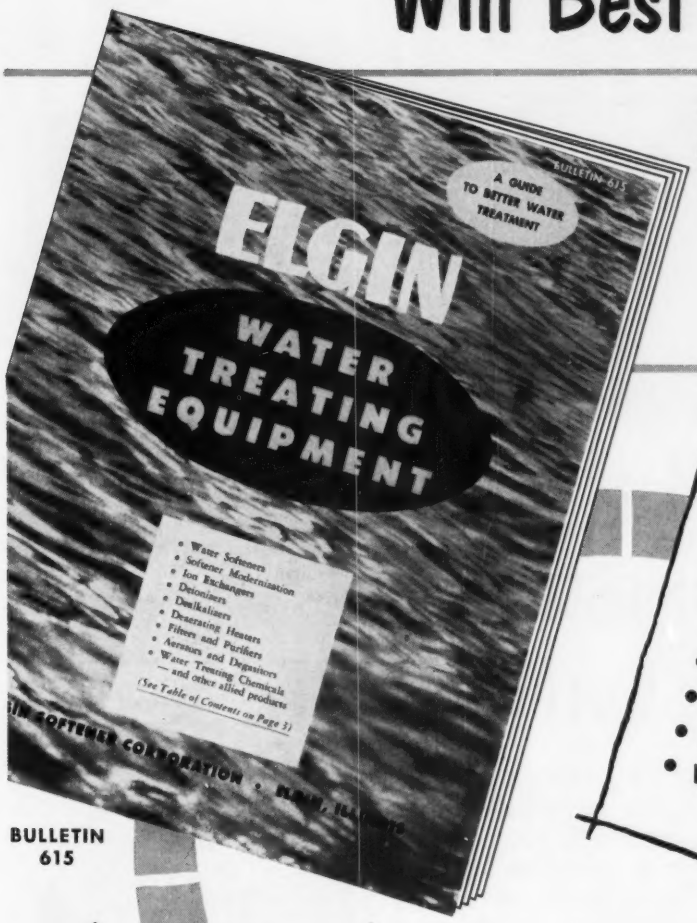


Rugged fans

43 • Bidding for varied industrial air-handling duties, fans boast aerodynamic design of wheel and housing inlet. They work quietly at lower speeds with greater efficiency, says maker. Smaller motors reduce power consumption, save space. These fans are available in seven sizes from 8¾ to 18¼ in., single and double inlets, up to 9-in. static pressure.—Chicago Blower Corporation

continued

Which Water Treating Equipment Will Best Fit the Job?



BULLETIN 615

This new 24-page bulletin will help you decide

See what it covers:

- Zeolite Water Softeners
- Demineralizers
- Dealkalizers
- Deionizers
- Filters
- Purifiers
- Degasitors
- Deaerating Heaters
- Water Treating Chemicals

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If you are confused about the many ways to treat water, this new bulletin will help you decide which is best for the job. It describes the various equipment used in treating water and what each is designed to do. Known for quality, dependability and advanced design, this equipment is based upon 50 years experience. For practical guidance in its proper application, the services of the Elgin representative nearest you is yours for the asking.

For a copy of our new booklet or to have our nearest representative contact you, simply mail the coupon.

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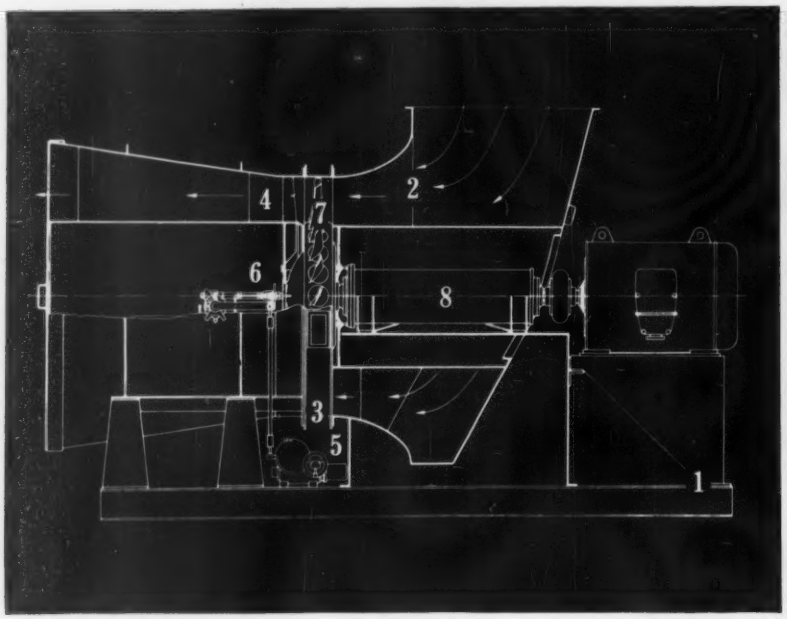

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1 *Base frame with motor support.*
2 *Inlet box and inlet cone.*
3 *Housing.*
4 *Diffuser with fixed guide vanes.*
5 *Servomotor.*
6 *Blade adjustment mechanism.*
7 *Fanwheel.*
8 *Main bearing assembly.*

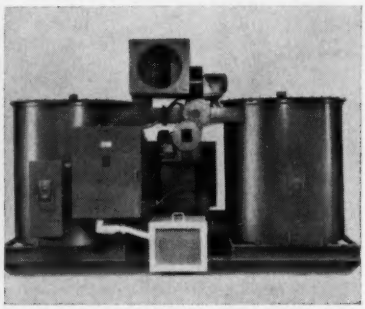
You name the country and we'll name the Variax installations. In utilities, industrial plants, government projects – wherever space is at a premium and a fan *fully controllable during operation* is needed – you'll find a Variax model at work. Capacity range is from 50,000 to 1,100,000 cu. ft/min. Designed in accordance with the latest aerodynamic principles, the Variax blade angle can be varied during operation to give optimum results and minimize losses. The short overall length of the Variax fan facilitates its easy, straight-forward incorporation in boiler plants and other installations. The Variax is ideal for parallel working. Parts and service facilities are maintained for this American fan and a full engineering staff can answer all your questions. Please write for full literature and the booklet "Axial Flow Fans for Boiler Draught Requirements" to:

NOVENCO INC.
40 Exchange Pl., New York, N.Y.
Tel. HA 2-5470

VARIAX

Equipment news

Begins on page 114



Automatic dehumidifier

23 • Packaged adsorption dehumidifier boasts high-capacity adsorption and reactivation systems, efficient high-flow, low-flow air-transfer valves. Unit handles 3000 cu ft of air per min, and maker states that it removes up to 75 lb of water in an hour.—Universal Dynamics Corp.

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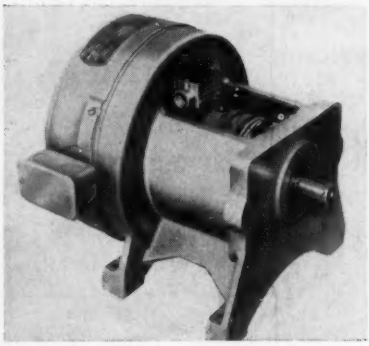
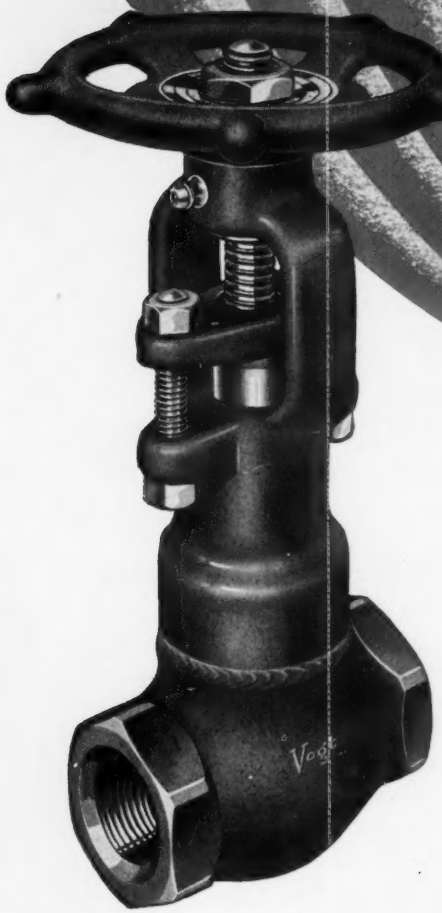


Machine drives handle fast start-stop cycles

45 • Drives store energy to meet momentary peaks up to ten times average load ratings. In this way, you can pick a motor size based on average needs instead of peak load. Drive includes a compact axial air-gap motor and integral clutch-brake coupling. Inside the motor, a high-inertia rotor spins constantly. Its flywheel effect stores kinetic energy, so when you engage the clutch and release the brake, output shaft hits top speed quickly.—Ferguson Machine Company

Another addition to the Vogt line of TOP QUALITY valves . . .



Forged Steel
WELDED BONNET

GENERAL GP PURPOSE

Gate and Globe
VALVES

150-800 Pounds Service

To eliminate forever potential body-bonnet leaks, Vogt engineers have developed these new General Purpose valves with seal welded bonnet joints.

This new addition to the world's most complete line of forged steel valves incorporates all the features of other Vogt GP valves—hard faced seats, hardened stainless steel wedges, drop forged pressure parts, and the numerous other advantages of Vogt's valve line.

The desirable safety feature of a back seat on the stem is retained while still offering the elimination of a possible body-bonnet leak.

Available NOW in both gate and globe types, ¼" thru 2", and in both socket weld and screw ends. These are priced identical to the bolted bonnet GP valves; gate valves the same as Series 12111 and globe valves the same as Series 12141.

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Series 2801 Gate Valve
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Series 2821 Globe Valve
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Both series identical in dimensions and have 13% chrome stainless steel trim.

Vogt GENERAL GP PURPOSE Vogt FOR BETTER VALVES

HENRY VOGT MACHINE COMPANY, Louisville, Ky.

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FORGED STEEL
VALVES

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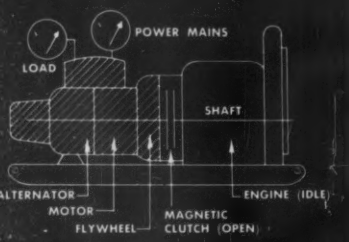
MICRO POWER . . .

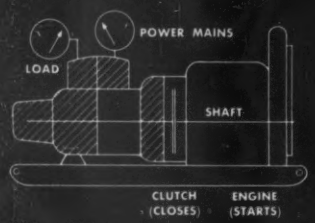
ANSWERS THE NEED

FOR A SOURCE OF CONTINUOUS, NO-BREAK A/C ELECTRIC POWER WHERE POWER INTERRUPTION CANNOT BE TOLERATED

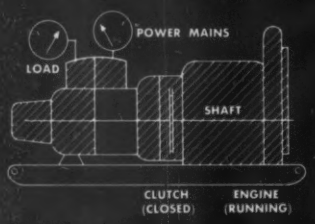
HOW IT WORKS



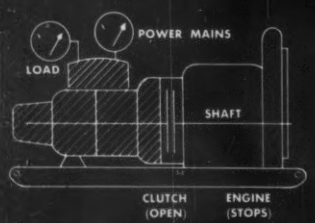
COMMERCIAL POWER MAINS NORMAL. LOAD SUPPLIED BY MOTOR AND ALTERNATOR.



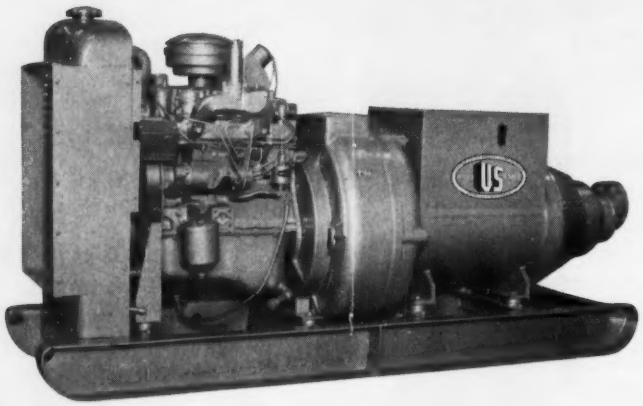
COMMERCIAL POWER MAINS FAIL. LOAD SUPPLIED TEMPORARILY BY FLYWHEEL. STANDBY ENGINE STARTS, MOTOR DISCONNECTED FROM MAINS.



STANDBY ENGINE AND ALTERNATOR SUPPLY POWER TO LOAD. SWITCHOVER ACCOMPLISHED WITHOUT LOSS OF USABLE VOLTAGE.



COMMERCIAL POWER RESTORED. LOAD SUPPLIED ONCE MORE FROM MOTOR AND ALTERNATOR.



New 5 KW MICRO POWER

Compact . . . Light Weight . . . Efficient MICRO POWER assures a constant source of stable voltage electric power regardless of prime power conditions. MICRO POWER serves as an independent power supply when there is complete commercial power failure, and as a voltage stabilizer when power from the prime source is at usable, but uneven value.

- no brushes, commutator, or slip rings to service, or replace, with new brushless generator
- optimum starting conditions
- squirrel cage motor with less than one percent slip
- electrical isolation from commercial source — voltage adjusting potentiometer
- magnetic amplifier regulator mounted directly on unit
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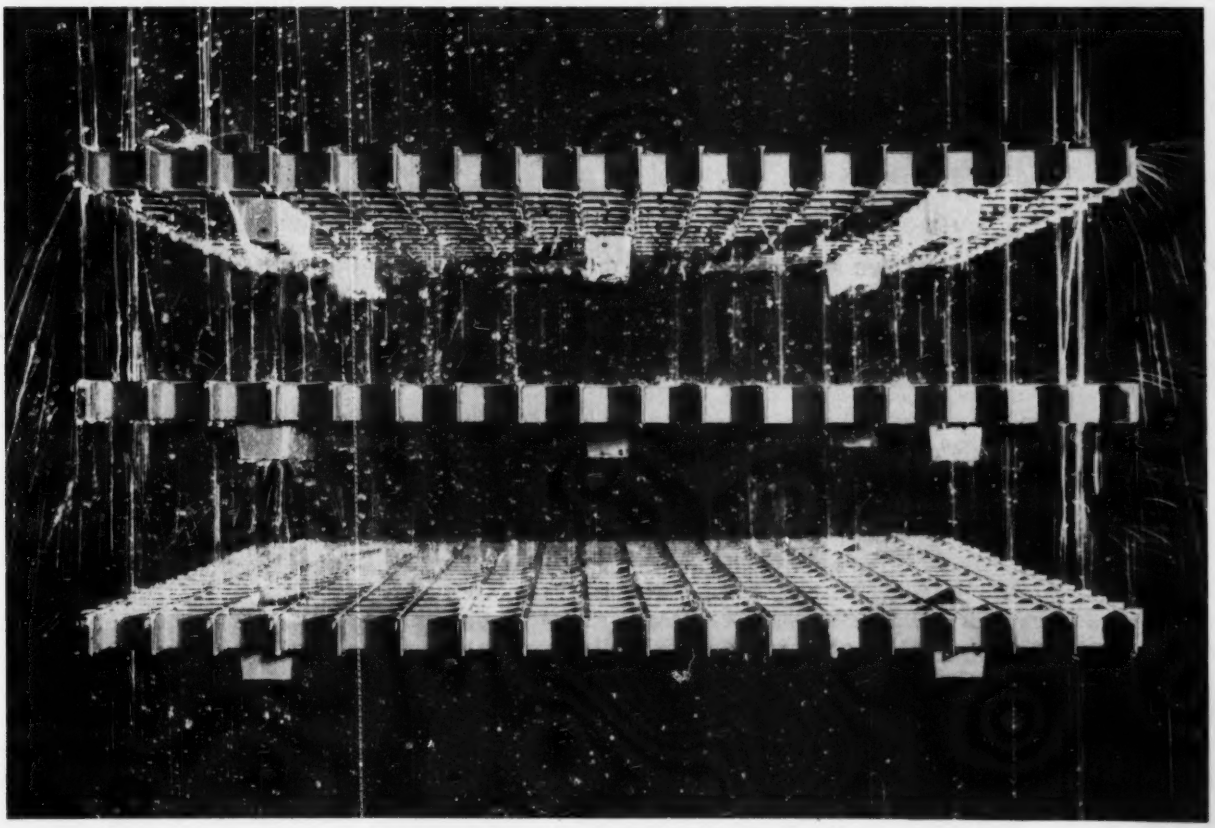

FOUNDER MEMBER COOLING TOWER INSTITUTE

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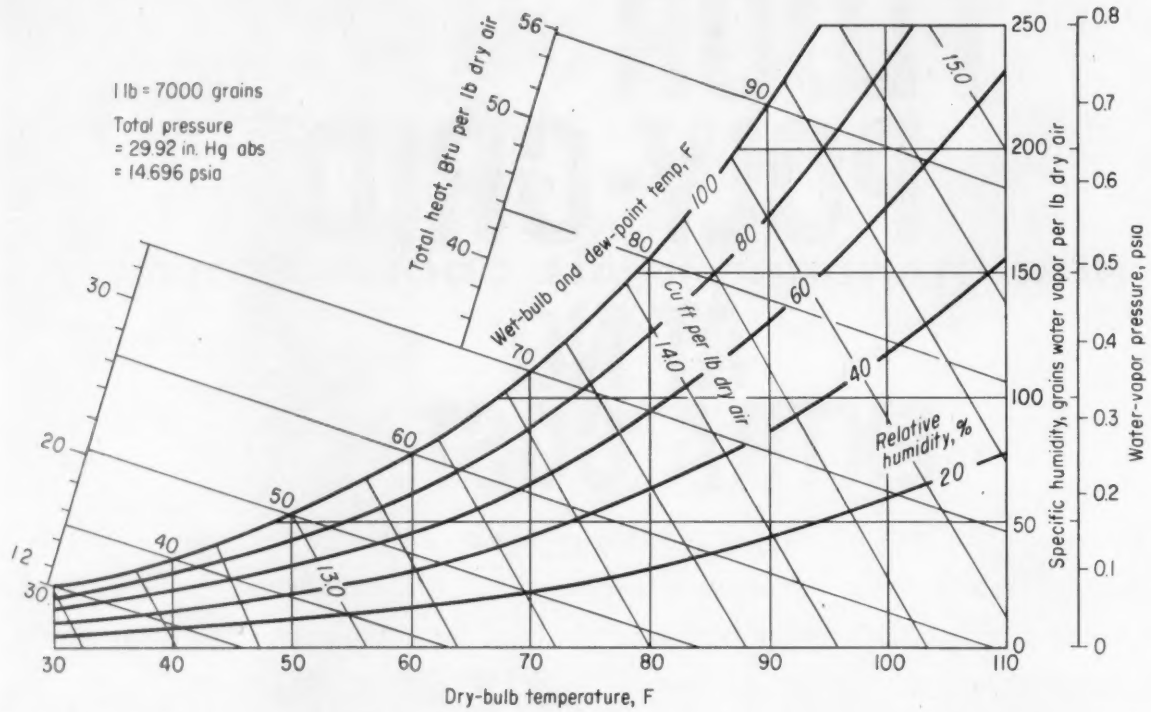

1 lb = 7000 grains
Total pressure
= 29.92 in. Hg abs
= 14.696 psia
Total heat, Btu per lb dry air
Wet-bulb and dew-point temp, F
Cu ft per lb dry air
Relative humidity, %
Specific humidity, grains water vapor per lb dry air
Water-vapor pressure, psia
Dry-bulb temperature, F

1 Psychrometric chart shows eight properties of air-steam mixtures at any one state for a given pressure — in this case, standard atmospheric as total pressure of the mixture. Process lines usually appear as simple straight lines when plotted here

THERMO REFRESHER NO. 54

Psychrometric chart checks processes

Air-steam mixtures can be controlled in a variety of ways. Here we learn something about the psychrometric chart, its uses and limitations. It can save much time in calculations

By B G A SKROTZKI, Associate Editor

In September (part 53) we studied methods of measuring air-steam mixtures. We developed formulas and demonstrated them in examples. Remember that the basic relations hold for all gas-vapor mixtures, although constants in the formulas for other mixtures will be different from those for air-steam. But since air-steam mixtures are the ones we meet most frequently in engineering, we'll concentrate on them.

First let's summarize the relations we developed. Specific humidity can be evaluated by:

$$\overline{SH} = 0.622 \frac{P_s}{P_g} \qquad (1)$$

Relative humidity is figured as:

$$\overline{RH} = \frac{P_s}{P_g} = \frac{SH}{0.622} \frac{P_s}{P_g} \qquad (2)$$

Specific humidity at a dry-bulb temperature, determined from dry- and wet-bulb readings, can be calculated from:

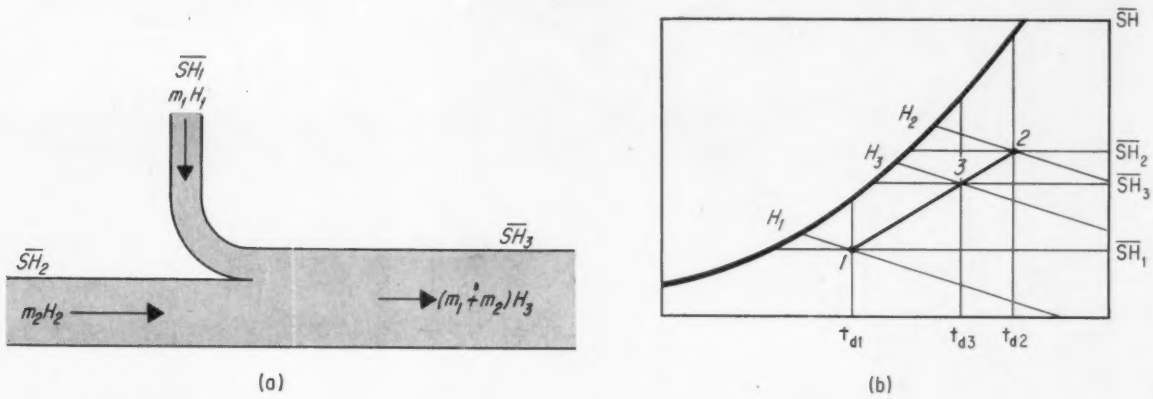
$$\overline{SH_d} = \frac{\overline{SH_w}\,(H_{sw} - H_{tw}) + H_{aw} - H_{ad}}{H_{sd} - H_{tw}} \qquad (3)$$

We can make this equation more inclusive by substituting from (1) and noting that:

$$H_{aw} - H_{ad} = 0.24(t_w - t_d)$$

We then get:

$$\overline{SH_d} = \frac{0.622 \frac{P_{sw}}{P_{aw}} (H_{sw} - H_{tw}) + 0.24\,(t_w - t_d)}{H_{sd} - H_{tw}} \qquad (4)$$



2 (*a*) Two streams of air-steam mixtures with different properties merge to form a leaving stream with still other properties. (*b*) Mixing of two streams can be easily figured on psychrometric chart to find properties of the leaving merged streams

In air-conditioning work, two more factors find frequent use: (1) enthalpy of the air-steam mixture and (2) total heat of a saturated air-steam mixture. For the first we have:

$$H_m = H_{ad} + \overline{SH}_d\, H_{sd} \qquad (5)$$

But convenience dictates measuring air enthalpy from 0 F and steam enthalpy from its usual 32-F level as a saturated liquid. Since we deal with *differences* of enthalpy this has no effect on the answers we seek. Substituting in (5) we get:

$$H_m = 0.24\, t_d + \overline{SH}_d(1060 + 0.45\, t_d) \qquad (6)$$

In this case H_{sd} is figured by an empirical formula, though we can take it from the Steam Tables if we wish and be slightly more accurate.

Total heat for a saturated air-steam mixture is defined:

$$\overline{TH}_m = 0.24\, t_w + \overline{SH}_w(1060 + 0.45\, t_w) \qquad (7)$$

Comparing with (6) we see that (7) is simply a special case of the former, being referred to the wet-bulb temperature.

Psychrometric chart, Fig. 1, summarizes the relations in equations (1) to (7). This skeleton chart usually has a counterpart with many more graduations than shown here so it can be read to four significant figures. Ordinarily the chart is computed for standard atmospheric pressure of 29.92-in.-Hg abs (14.696 psia). In most work the chart may be used for pressures ranging from 29.0 to 31.0-in.-Hg abs without introducing significant error. Some charts incorporate correction factors so you can take care of these deviations.

Ordinates of the chart are dry-bulb temperature and specific humidity of the air-steam mixture. With given total atmospheric pressure and specific humidities, equation (1) shows that the partial pressure of the water vapor has a simple relation to humidity, so we have a simple adjacent scale at the right of Fig. 1. Humidity is in grains of water vapor per lb of dry air, and 1 lb is equal to 7000 grains.

Slightly tilted from the horizontal is a family of straight-line curves for wet-bulb temperature. These meet dry-bulb temperature lines with the same numbers at the saturation curve. The latter curve also gives 100% relative humidity and the dew-point temperature. The family of relative-humidity curves flares up to the right.

Tilted sharply upward, another family of straight-line curves gives the specific volume of the dry air. Finally we have a scale for total heat at right angles to the wet-bulb curves. Strictly, these curves and scale apply only to the saturated mixture, but we can assume they also apply to enthalpy of the mixture, if high accuracy is not essential.

So we have here nine factors tied together in a calculating chart: (1) dry-bulb temperature (2) wet-bulb temperature (3) specific humidity (4) relative humidity (5) water-vapor partial pressure (6) dew-point temperature (7) dry-air specific volume (8) total heat (9) mixture's total pressure. The chart, of course, does not take any account of varying total pressure.

Knowing any two factors on this chart lets us fix six others with little or no auxiliary calculation. The chart proves to be an important tool for process calculations. Let's learn how to use it in air-conditioning problems.

Adiabatic mixing, Fig. 2, considers two streams of air-steam mixtures merging into one to yield a given dry-bulb temperature and specific humidity. To solve this problem we apply a first-law energy balance and a conservation-of-mass balance. These tell us:

$$m_1H_1 + m_2H_2 = m_3H_3 = (m_1 + m_2)\, H_3 \qquad (8)$$

where the m's refer to the masses of dry air in each stream and the H's to the enthalpy or total heat. Looking at the vapor in the streams we can write:

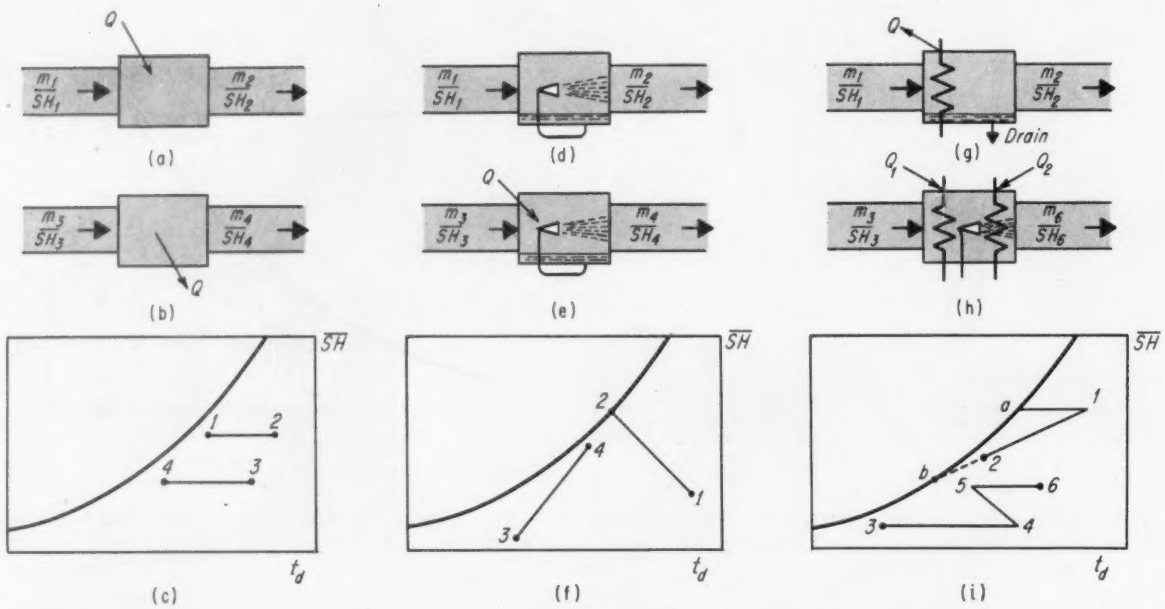
$$m_1\overline{SH}_1 + m_2\overline{SH}_2 = m_3\overline{SH}_3 = (m_1 + m_2)\overline{SH}_3 \qquad (9)$$

Rearranging both (8) and (9) and solving for the leaving factor we find that:

$$H_3 = \frac{m_1}{m_3} H_1 + \frac{m_2}{m_3} H_2 \qquad (10)$$

$$\overline{SH_3} = \frac{m_1}{m_3}\overline{SH_1} + \frac{m_2}{m_3} SH_2 \qquad (11)$$

continued



3 (*a*) Mixture-heating and (*b*) mixture-cooling processes appear as horizontal lines on (*c*). (*d*) Adiabatic humidifying cools mixture; adding heat as in (*e*) can warm mixture as shown in (*f*). (*g*) Cooling dehumidification is a 2-part process with subsequent mixing. (*h*) Processes can be combined as needed. (*i*) Psychrometric chart shows processes for both (*g*) and (*h*) above

These equations show that properties of the mixed stream are the weighted averages of the properties of the incoming streams.

Selecting any two points *1* and *2* on the psychrometric chart, Fig. 2*b*, we see that all weighted averages of any of the properties of the two states fall on a straight line connecting the two points. So to find the averaged state all we need do is locate both initial points on the psychrometric chart, draw a straight line between them, solve any one equation for a leaving property as in (10) or (11) and spot it on the connecting line as at *3*. We then can read all other properties for the leaving air-steam flow.

Example: On a full-scale psychrometric chart find the final properties of mixing two streams of equal mass, one with $t_d = 93$ F and $\overline{TH} = 45.75$ Btu per lb dry air and the other with $t_d = 73$ F and $\overline{TH} = 23.3$ Btu per lb dry air.

Solution: We need to find the simple average of either property, so:

$$\overline{TH}_3 = \frac{\overline{TH}_1 + \overline{TH}_2}{2} = \frac{45.75 + 23.3}{2} = 34.5 \text{ Btu}$$

$$t_{d3} = \frac{t_{d1} + t_{d2}}{2} = \frac{93 + 73}{2} = 83 \text{ F}$$

We find that both these averages lie on the straight connecting line between *1* and *2*. Then we can read that $\overline{SH}_3 = 92$ grains per lb dry air; $t_{w3} = 70.5$ F and $V_{a3} = 13.96$ cu ft per lb dry air.

Heating and cooling a stream of air-steam mixture, Fig. 3*a* to *c*, shows as horizontal process lines on the psychrometric chart, 3*c*. Fig. 3*a* shows a stream $m_1 = m_2$ flowing through a heat exchanger that adds heat Q to the mixture. Since no vapor is added during this process, $\overline{SH}_1 = \overline{SH}_2$, but note that $\overline{RH}_1 > \overline{RH}_2$, $t_{d1} < t_{d2}$ and $t_{w1} < t_{w2}$.

Fig. 3*b* shows a stream $m_3 = m_4$ flowing through a heat exchanger which extracts heat from the air-steam mixture. Since no vapor is added, $\overline{SH}_3 = \overline{SH}_4$, but other properties change in reverse direction of heating.

For the general case we can evaluate heat transferred as:

$$Q = H_{m1} - H_{m2} \qquad (12)$$

for either heating or cooling the mixture stream.

Adiabatic humidifying, Fig. 3*d*, adds water (in contact with the air-steam flow) to the stream. This arrangement cools the water to the saturation temperature t_w when steady flow has been established. We derived the energy balance for this process in part 53, formulating equation (3); in terms of Fig. 3*f* the balance is:

$$m_1 H_1 + (\overline{SH}_2 - \overline{SH}_1) m_{a1} H_{fw} = m_2 H_2 \qquad (13)$$

where

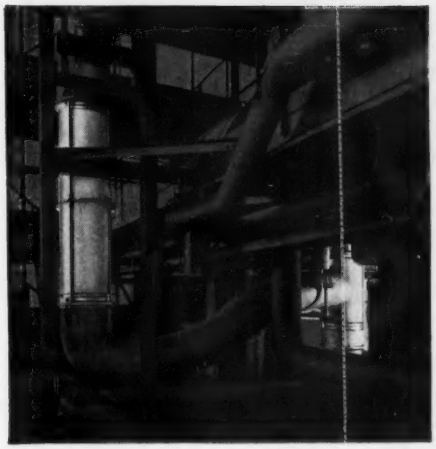
$$m_{a1} + m_{s1} = m_1 \qquad \text{and} \qquad m_{a1} + m_{s2} = m_2$$

As Fig. 3*f* shows, this raises the specific humidity from *1* to *2* but drops the dry-bulb temperature from t_{d1} to t_{d2}. The process need not be carried to saturation as shown here. Point *2* can be controlled to fall short of the saturation curve, and usually is so placed in practical systems. The process line can be assumed to follow the constant total-heat or wet-bulb-temperature line where results needn't be too accurate. For strict accuracy the process line follows the line of constant enthalpy, assuming the water injected is at some value other than t_w.

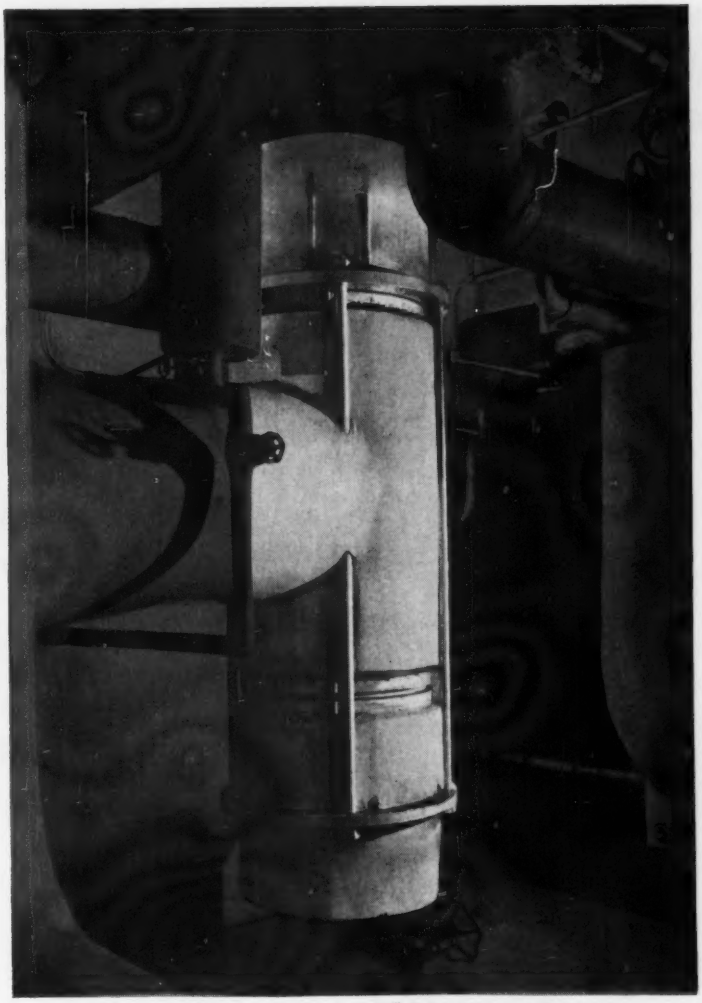
Heating and humidifying, Fig. 3*e*, adds the factor of heat addition Q to the adiabatic humidifying in part 53. For the energy balance we need to add Q to (13) to get:

$$m_{a3} H_{ad} + m_{s3} H_{sd} + (\overline{SH}_4 - \overline{SH}_3) m_{a3} H_{f4} + Q = m_{a3} H_{a4} + m_{s4} H_{s4} \qquad (14)$$

continued



In the foreground, a 20" ZALLEA Universal Expansion Joint absorbing lateral movement.



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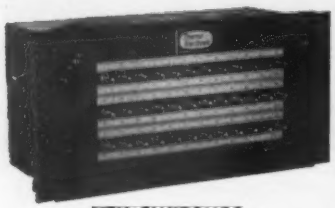

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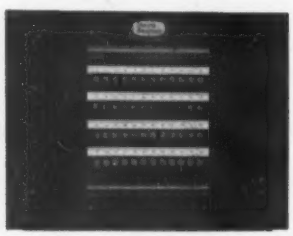

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Thermo refresher

Begins on page 130

Here we expanded the equation to show all the mass elements and individual enthalpies. Fig. 3*f* shows the process line *3-4* indicating a rise in $\overline{SH}$, t_d and t_w as well as in V.

Dehumidifying and cooling an air-steam stream, Fig. 3*g*, passes the flow over cooling coils to lower its enthalpy by removing heat Q. The portion of the flow in direct contact with the coils follows cooling process *1-a-b*. In the first part *1-a*, cooling takes place at constant specific humidity with that part of the flow becoming saturated at *a*. With further cooling below *a*, moisture starts condensing to some saturated state as at *b*. Then the directly cooled part at *b* mixes with the rest at state *1* and the final state of the total mixture will be at state *2* on a straight line connecting *1* and *b*.

Energy balance for the overall process is:

$$m_1 H_1 = m_2 H_2 + (m_1 - m_2) H_t + Q \quad (15)$$

For the entire mass of mixture to reach state *b* we would need a very large heat exchanger.

Combined processes, Fig. 3*h*, can use any of the principles we discussed to condition air. Here we see a heating process at constant humidity followed by an adiabatic humidifying process with a final constant-humidity heating process. Such an arrangement gives flexibility in conditioning large amounts of air to close tolerances.

Fig. 3*i* shows the three processes on a psychrometric chart. Carrying on process *3-4* indefinitely would produce quite dry, hot air. If *4-5* were carried on to saturation the mixture would have a higher humidity and be somewhat cooler. Process *5-6* brings the air to desired humidity and dry-bulb-temperature levels.

Next and final part of this series will apply some of these principles in examples and end with a study of cooling-tower principles.

Computer study of reactor-core power-generating characteristics for the Douglas Point Nuclear Power Station to be built in Canada will be done by Allis-Chalmers Manufacturing Co

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(† *Caskey and Harding,* American Power Conference, 1957).

***COUNTERFLOW** *is the trademark of Illinois Water Treatment Company equipment utilizing an up-flow method of regeneration with a "barrier" to keep the bed from expanding. U.S. Patent No. 2,891,007.*

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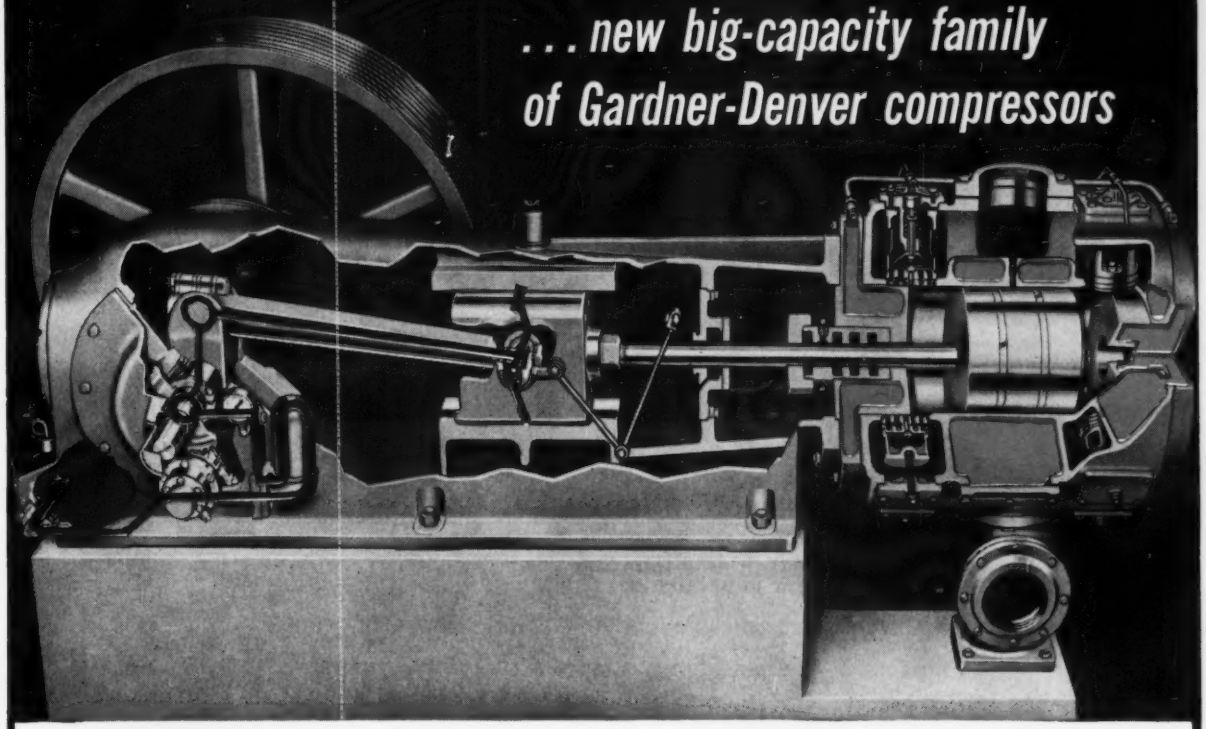

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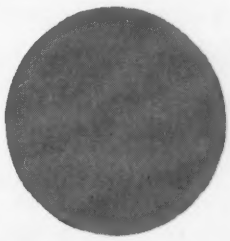

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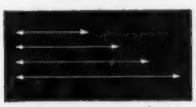

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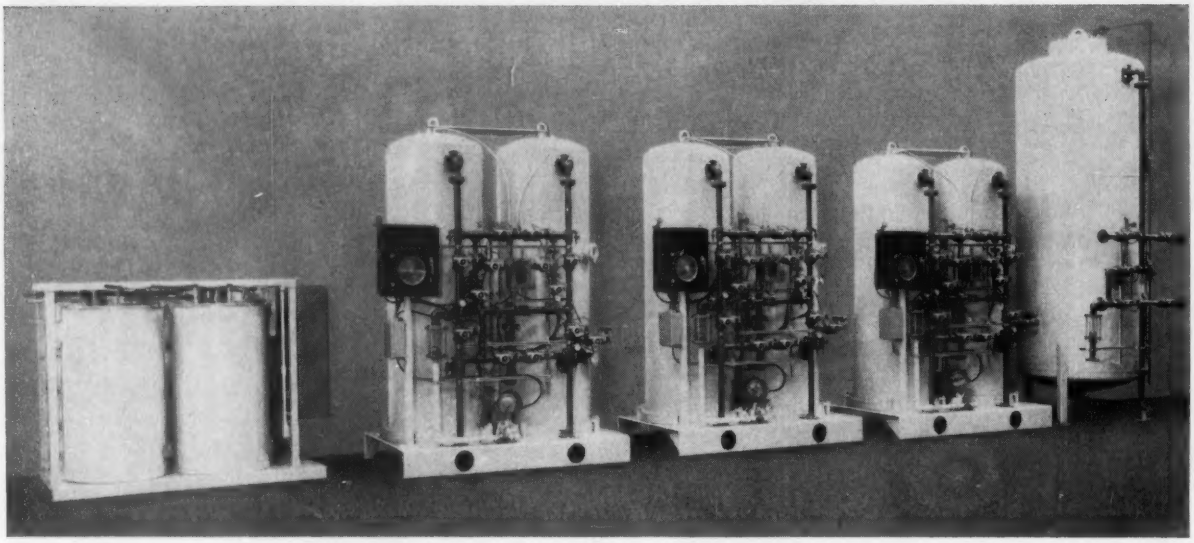

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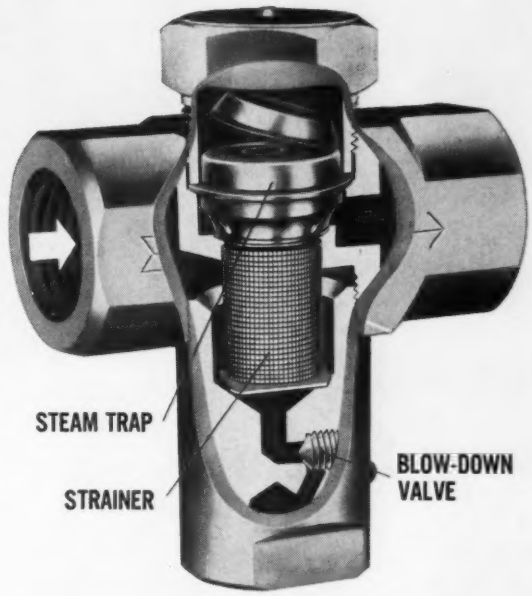
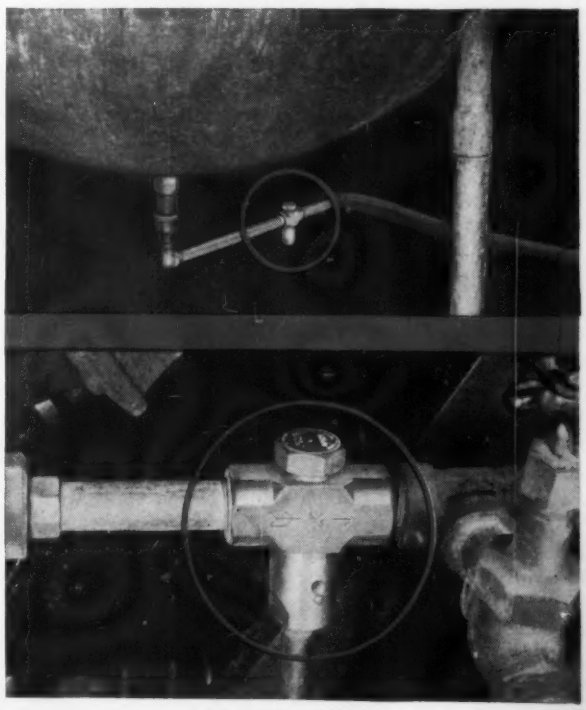


CHEMICAL PLANT REDUCES CORROSION FAILURE —LIKES "COMPACT" DESIGN

For years, traps and strainers of iron and steel were subject to HCl and H_2SO_4 acid corrosion failure in this chemical plant. Installations lasted only a few months. Now Yarway Series 130 steam traps are solving this corrosion problem because the trap, strainer and blow-down valve are combined in *one stainless steel body*. In addition, trapping hook-ups on processing kettles are greatly simplified.



LAUNDRY OVERCOMES SPACE PROBLEM...GETS FASTER HEAT-UP, NO WATER HAMMER

Space was at a premium for steam trapping around the presses in this laundry, and also they couldn't get fast heat-up without water hammer. Yarway Series 130 combination steam traps solved all three problems to their complete satisfaction.

For more facts circle 284 on Reader Service card, p 99

"As you were—don't let go the stern lines yet, Mr Smith," roared Marmaduke. "We're talking about $80,000 and that's a lot of pea soup!"

Marmy's sharp-frozen peas

It was the middle of June and Clyde County was smack-dab into pea-picking time. Every available farm hand and migrant worker was out in the fields, working feverishly to harvest what looked like the biggest pea crop on record. But the busiest spot of all was the Clyde County Cold Storage Company.

Peas were being rushed to the plant by truck and wagon from every direction on the compass—all roads seemed to end at the cold-storage plant. Sharp freezing the peas on time, and to the right temperature, was the very lifeline of Clyde County.

But there was a frog in the molasses, and no one was more concerned about it than chief engineer Hugh Dermott. It wasn't his ammonia compressors that had him worried. They had been running night and day for a week, pulling down the temperatures of the large storage spaces so the peas would get a cold reception when they arrived. It was the six battery-operated lift trucks that had him and Pete Smith, the owner, sweating.

Prompt storage for the freshly picked peas meant the difference between a healthy profit and sickening loss for everyone concerned. The one time of the year when they were really needed to quickly unload the farmers' overflowing trucks and wagons and tuck the peas into their frosty beds, and those lifts had to conk out.

It all started because Hugh Dermott was a better friend than he was an operating engineer, especially as far as electricity is concerned. Hugh's neighbor, Alf Strickler, ran a garage in town. Alf's battery charger was on the fritz, so he asked Hugh if he could take his batteries to the cold-storage plant. His farmer customers needed batteries to power their pea-harvesting equipment.

Soon as the batteries were lined up, one of Hugh's helpers hooked them to the self-excited charging generator in series parallel, to get the proper load. But as he connected the batteries to the generator, he unwittingly reversed the polarity. When they started the m-g set, the generator fuses blew. The operator replaced the fuses; again they blew. So Alf loaded his batteries back onto the truck and turned tail for his garage.

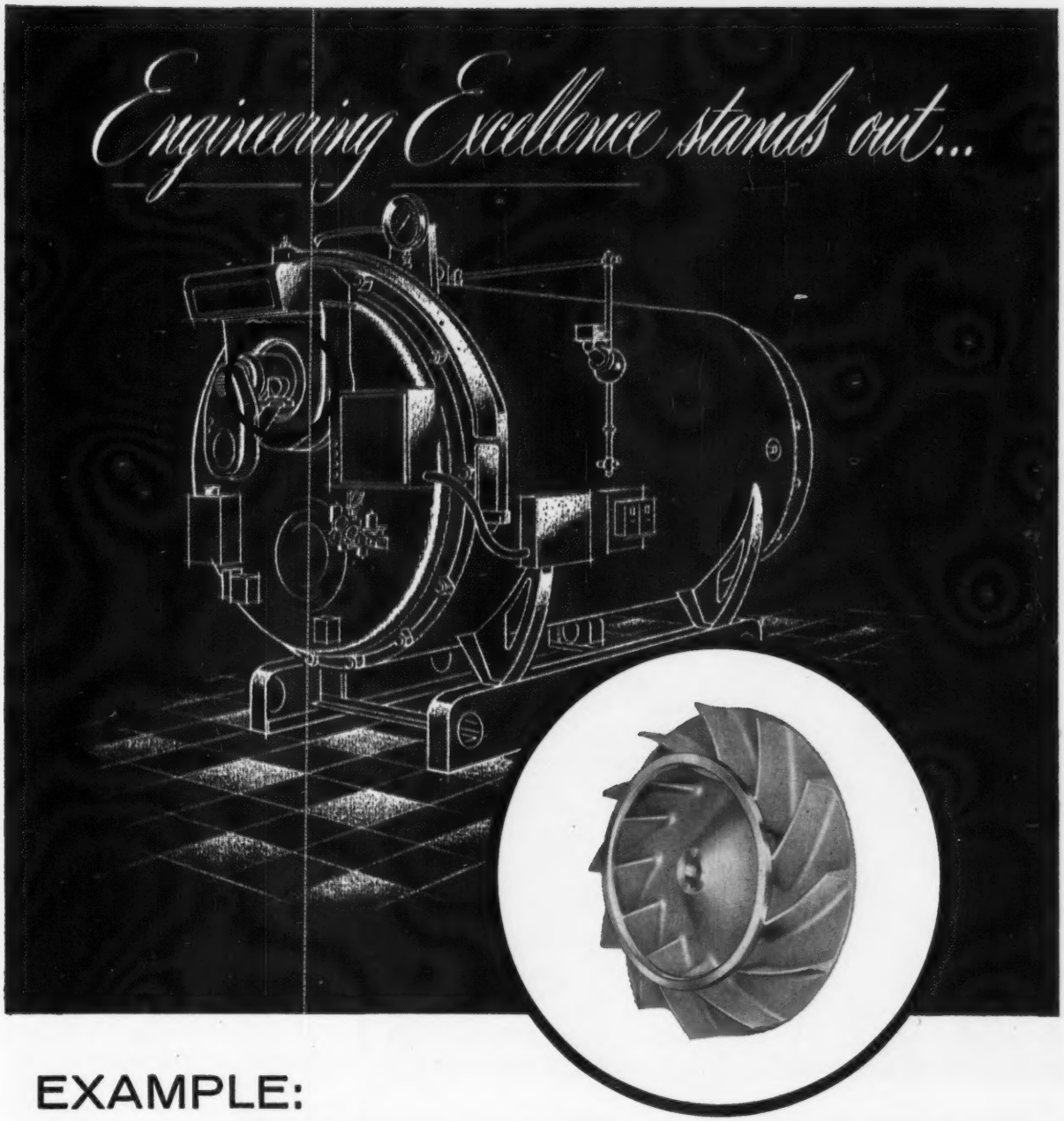
But that evening—which was the first day of the pea season—the lift trucks couldn't be charged. Every time a battery's polarized plug was plugged into the charger, the generator fuses blew. By next noon, the half-dozen lift trucks just barely crept over the floor. Hugh did have the presence of mind to herd them into the charging room on their last gasping breath. And there they sat, like so many stubborn mechanical mules.

But there was no time to lose. A bumper pea crop was coming in from the fields. Lift trucks or no lift trucks, those peas had to be sharp frozen, and quickly. That would make the difference between getting top prices for prime produce and taking what the canners offered.

Hugh Dermott sat up half the night telephoning around the county to round up all the stray hand trucks. Then he had the boss hire an extra crew to man them.

So the business of unloading the planters' big trucks and wagons went on around the clock. It was coolie work, and the weather was downright hot. Talk about slave dock wallopers along the Mississippi wharfs back in the antebellum steamboat days—this was IT, only at a much

Engineering Excellence stands out...



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This patented fan is the heart of a highly efficient forced draft system. Unique in design and function, this caseless impeller — made of sturdy cast aluminum, located deep within the front head of the boiler — provides combustion air at the required pressure and in the proper quantity to assure you of peak efficiency at any load level.

Efficiency extends into the area of maintenance, too. This fan never needs cleaning. Direct drive connection, without special bearings or V-belts, keeps the operation free from trouble... contributes to the quietest operation for any boiler you can buy today. Good reason why you should *insist* on Cleaver-Brooks.

Your Cleaver-Brooks agent has years of experience in boiler application. Contact him for more information on the features that exemplify the engineering excellence of Cleaver-Brooks.

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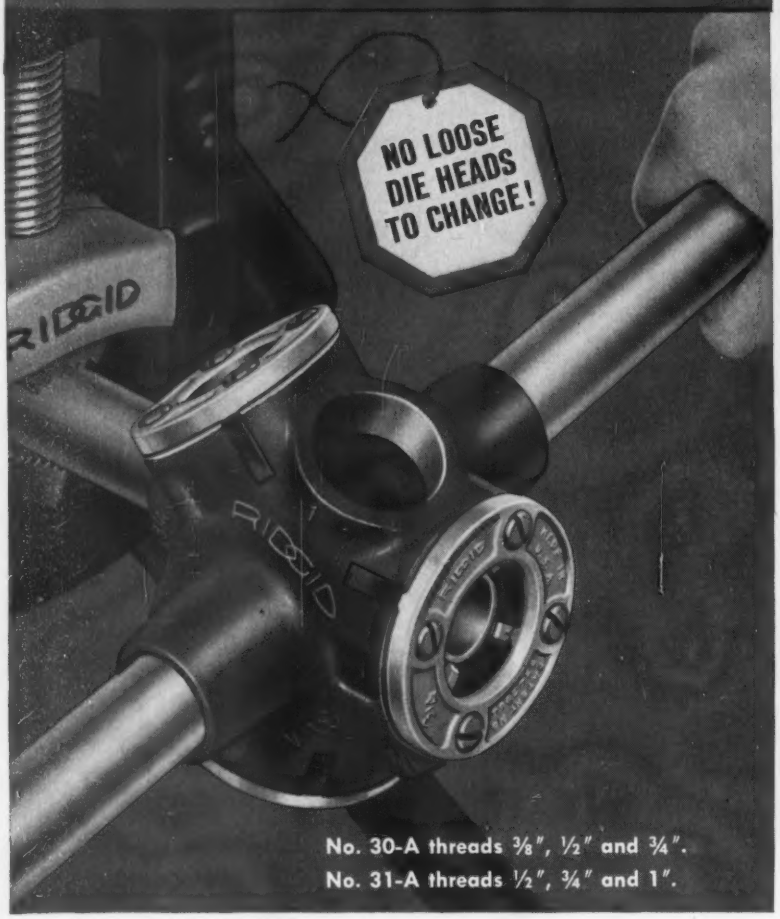
PERFORMANCE PROVES THE ENGINEERING EXCELLENCE OF CLEAVER-BROOKS BOILERS

Just One RIDGID
3-WAY PIPE THREADER
Threads All 3 Popular Conduit Sizes!



No. 30-A threads ⅜", ½" and ¾".
No. 31-A threads ½", ¾" and 1".

Here's an extra-sturdy threader that's instantly ready to thread any of the three conduit sizes most used. Each die-set is locked in place . . . can't get lost. Yet dies are easy to reverse for close-to-wall threading. Centering guide keeps conduit straight for true-threads every time. Twin handles double leverage for easy thread cutting. Choice of long-wearing alloy or high-speed steel dies. Straight conduit dies also available.

Call your distributor today. For your convenience he maintains a complete stock of RIDGID Work-Saver Pipe Tools and parts.

RIDGID
The Ridge Tool Company, Elyria, Ohio, U.S.A.

Marmaduke

Begins on page 138

faster pace. Hugh Dermott himself got on one end of a hand truck. The crop would be saved—even if it took three times as long to do the job, and even if the peas didn't bring top prices.

This was the picture at Clyde County Cold Storage when Marmaduke Surfaceblow, inspector for the Central Machinery Insurance Co of Chicago, parked his old Duesenberg sports car, the one with the two complete ignition systems, next to the boiler house.

The husky 6-ft 4-in. inspector slammed his car door shut, blinking his eyes a few times as the full glare of the noon sun hit him. He recalled his last visit here. Then they were having costly compressor breakdowns from overfeeding liquid ammonia to the evaporator coils. He sat down with Pete Smith and sketched out a piping system with a heat exchanger on its low side that would prevent that headache. Then he spent the evening explaining it to the chief engineer. It was all beyond the call of duty—but Smith had not even sent him a bottle for Christmas.

Suddenly he doubled his huge fists, stretched and let out a mighty yawn. Friday night he'd be in Chicago, dancing with his girl friend Betty Crane. She'd make him forget about boilers and compressors—but he could use some extra spending money.

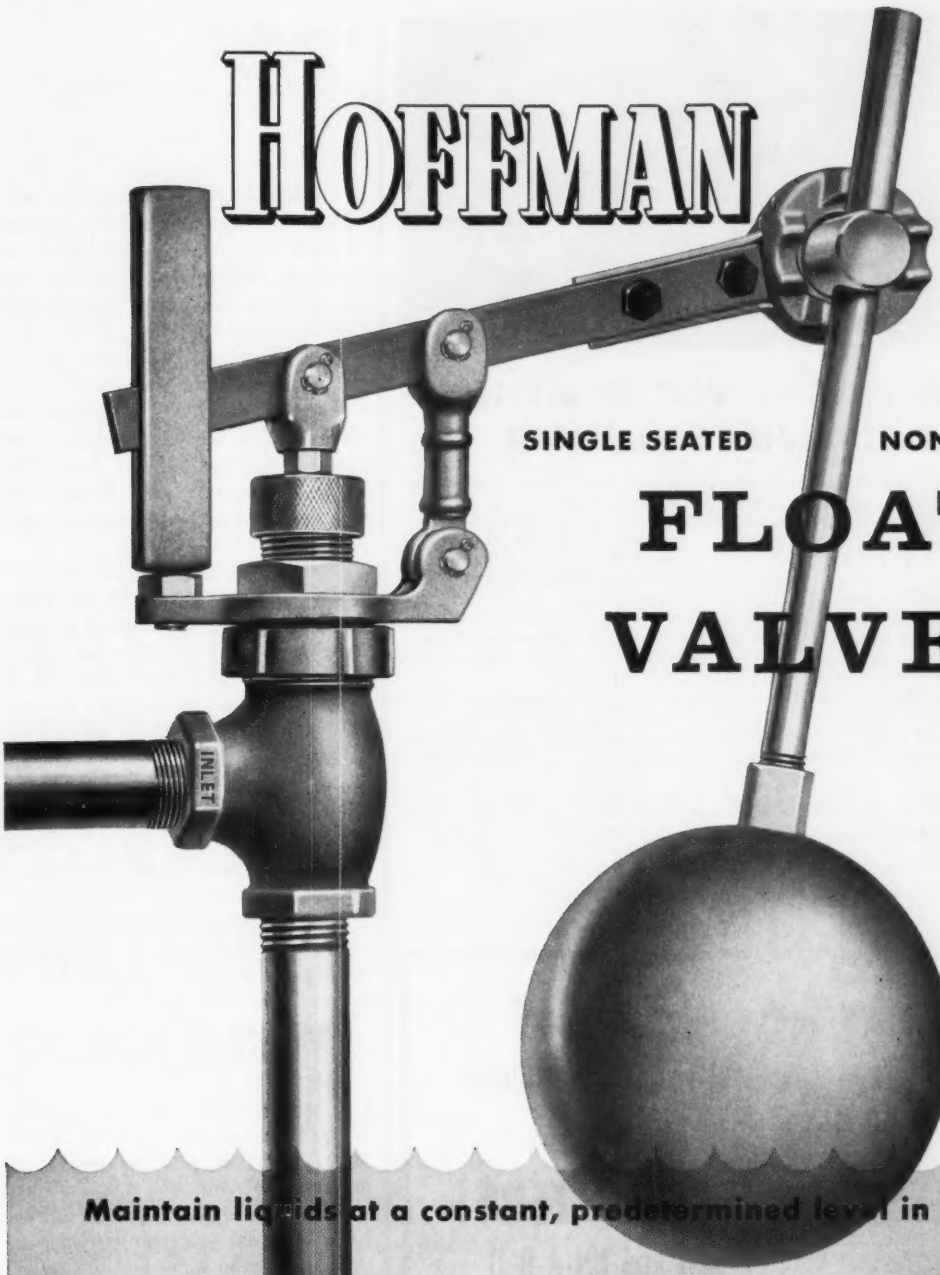
Now that he was wound up and ready for action, he glanced at the loading platform. It was crowded with parked trucks, all filled with peas. And the road along the highway was clogged with more loaded trucks. The farmers were milling around, grumbling to one another.

As Marmy looked toward the loading platform again, everyone seemed to be pushing a hand truck. Pushing, hell—they were shoving them and trotting; looked as if they were trying to win a race. What Marmy saw there threw him off his stride. Instead of heading for the compressor room, he gave his gray bowler a starboard list, lit a cigar and headed toward the activity along the platform.

But just as he climbed the six steps to the high platform, a shiny Lincoln

For more facts circle 286 on Reader Service card, p 99

HOFFMAN



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When you install Hoffman Float Valves, you always have just the precise quantity of liquids required in your open storage tanks, process tanks, cooling tower basins . . . tanks won't overflow, nor will liquid level drop below specified range. Hoffman engineered Float Valves, available in either globe or angle pattern, have brass bodies, seamless copper floats, and special "Buna-N" discs for reasonably clear liquids with a maximum temperature of 200°F. Sizes: ¾" to 3": operating pressures to 100 P.S.I. maximum.

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Radiator Vents | Main Vents | Radiator Traps | Hot Water Circulators | Condensation Pumps | Temperature Regulators | Strainers

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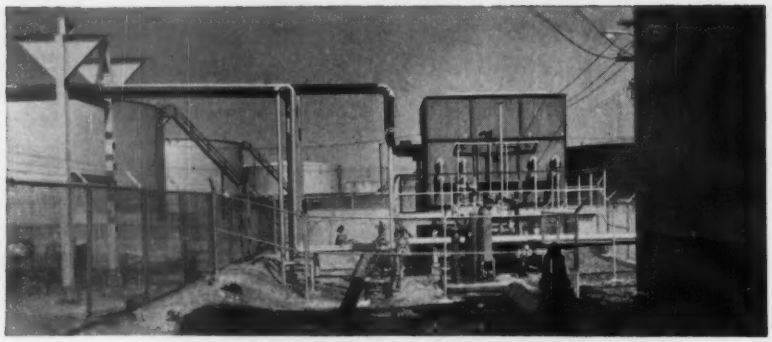

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The system is self-contained... no cooling tower or spray pond is required. You save not only the cost of condensing water but also the expenses of piping and pumping, and the cost of water handling equipment.

In the Niagara Vapor Condenser the heat is removed at the rate of input and the cooling effect, directly proportional to the load, is controlled by varying the amount of air passing over the cooling surfaces. Operation is automatic and trustworthy.

Liquids and vapors are always held at constant temperature under close control. You get uniform distillation products the year round. You get better quality and increased production.

Non-condensibles are effectively separated and sub-cooled, giving you better vacuum pump operation. You save power and steam.

Niagara *Aero* Vapor Condensers are manufactured in standard units in a range of capacities up to thirty million BTU's. Write for full information; ask for Bulletin 139-R.

NIAGARA BLOWER COMPANY

Dept. P11, 405 Lexington Ave., New York 17, N. Y.

Niagara District Engineers in Principal Cities of U.S. and Canada

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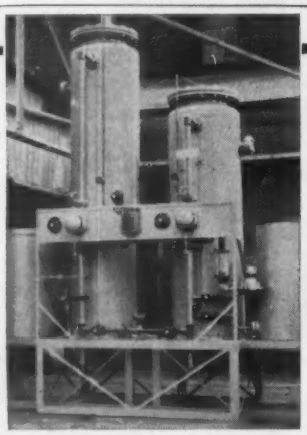

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Write for details of Two-Bed and Un-A-Bed Demineralizers

HUNGERFORD & TERRY, INC.

CLAYTON 3, NEW JERSEY

Marmaduke

Begins on page 138

limousine screeched to a halt in back of him. Two men jumped out, one out of each front door. They raced up the steps, passing Marmy on the double. Why all this hurry and why did they head for the office on the platform's other end? All this puzzled the swashbuckling inspector.

Then he suddenly recognized the chief engineer himself pushing a hand truck. Sweat was pouring down Dermott's contorted face. Marmaduke stood still for a minute, not believing his eyes.

Just as he started toward Dermott and called out, "What's all this grunt and groan business, Chief?", the two men from the Lincoln came toward them. They had a third man in tow. All three seemed to be angry or worried, Marmy couldn't tell which. But he recognized the third man as Pete Smith, owner of the cold-storage plant.

Barging up to the chief, Smith called out, "Say, Hugh, the Schultz brothers here want to talk with us." The chief dropped the handles of his empty hand truck and walked toward them, mopping the sweat from his red face with a large bandana.

Upon seeing the chief engineer, the taller of the two brothers opened up. "Look here, Dermott, how in hell long you gonna hold up our trucks? We got tons of peas piled up at our farms and more stacking up by the minute. But you won't unload our trucks fast enough to get those peas here. What are you trying to do, ruin the biggest crop we've had in years?" By then, the farmers were leaving their parked trucks and gathering around to listen.

Hugh Dermott just stood there. He looked as helpless as a speared fish. When Schultz finally closed his mouth, the chief hurriedly briefed him on how his charging generator went haywire when he tried to help out Alf Strickler. And the only guy in that neck of the woods who knew anything about fixing a battery charger was over in Wabash county having his gall bladder removed. So what could Hugh do but use the hand trucks?

"Sure, but who's gonna pay us for all those peas we got harvested and

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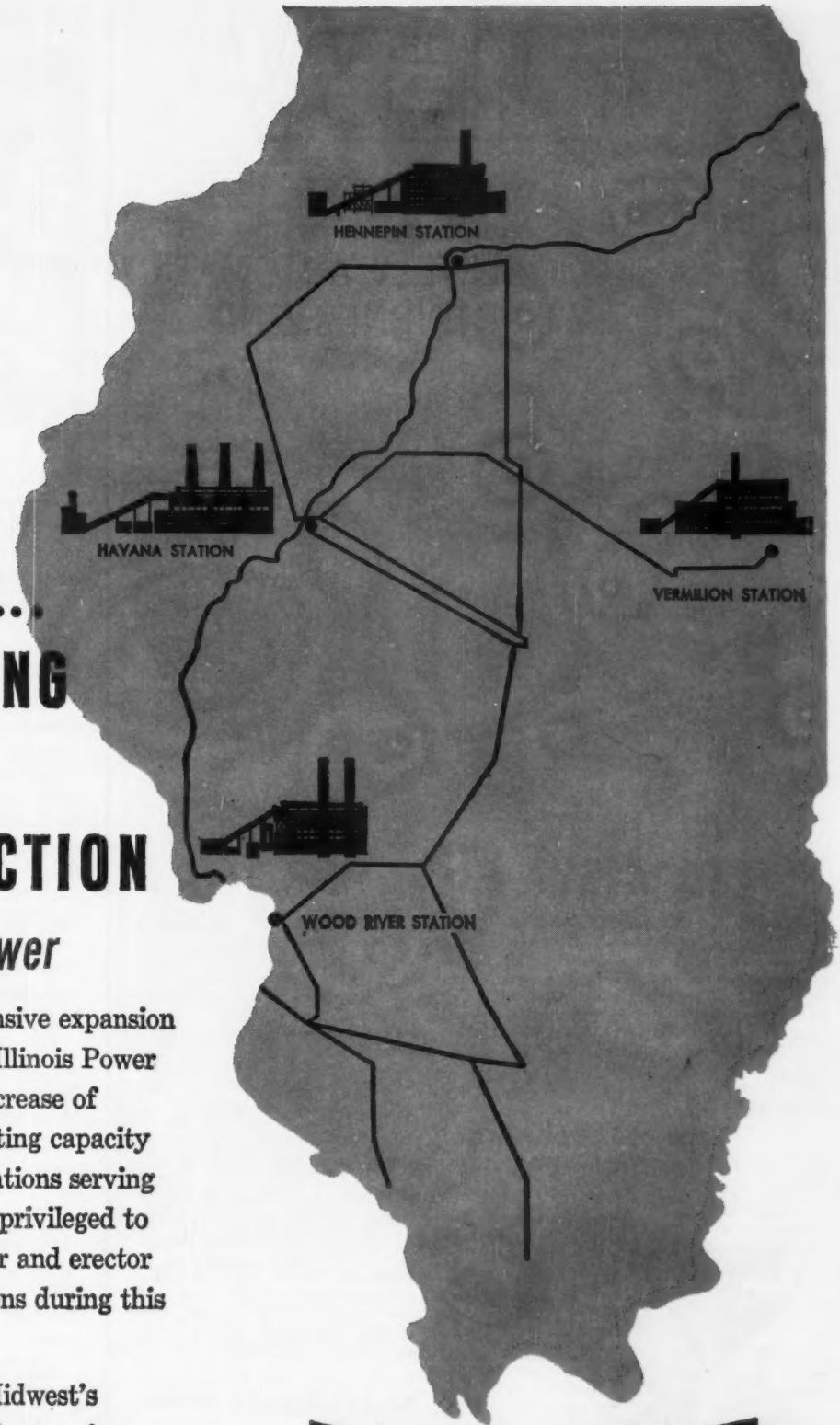

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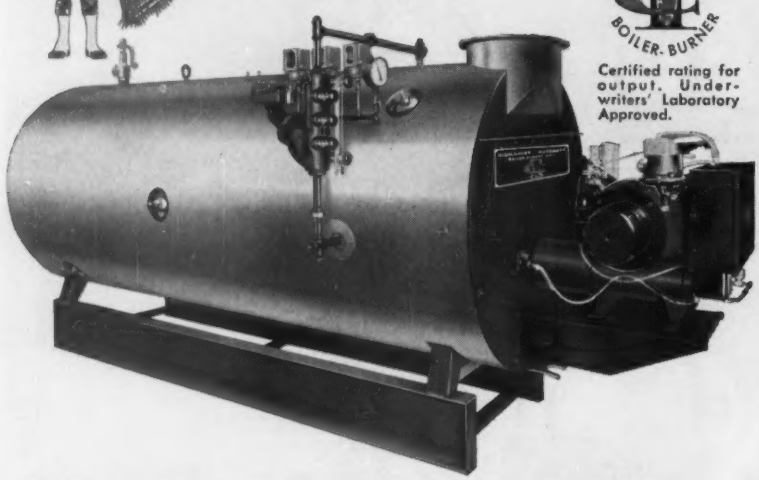

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SAVES ON INSTALLATION. The new Highlander is a completely assembled boiler-burner plant. Installing one simple unit saves money. Designed by Engineers with years of experience in matching burners and boilers for the exact job—whether it is power, processing or heating. No problem of taking a boiler and trying to match a burner to it. The Highlander Boiler-Burner unit is design-controlled at the factory.

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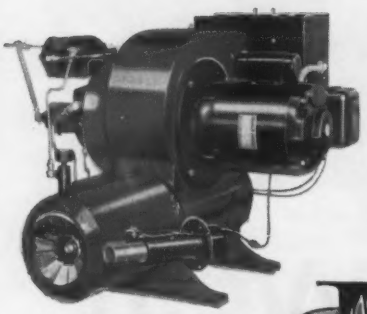

HEART OF THE HIGHLANDER is the famous Industrial Combustion Burner. The HEV-E-OIL Burner engineered to use inexpensive No. 4, 5 and 6 heavy oils is shown here. Available from 5 to 150 gph. HEV-E-DUTY Power Gas Burners and Combination gas/oil Burners from 720,000 to 21,000,000 BTU.

Write Dept. J-111 for complete information.

INDUSTRIAL COMBUSTION INC.

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Marmaduke

Begins on page 138

spoiling by the minute?" piped up the smaller of the Schultz duo, his nasal voice rising to a squeak.

"Do you know that dumb trick of yours can cost us $80,000 in the next two days?" cut in his big brother, staring bullets through the chief. Smith and Dermott exchanged worried glances, but said nothing. What could they say?

"BILGEWATER on giving $80,000 worth of peas the deep six," suddenly roared a foghorn voice. "I'm Marmaduke Surfaceblow, the machinery inspector, and I've got nothing to do with your lift-truck battery charger. But if that rig hasn't burned up completely I might be able to put you back into business."

"Why of course, Mr Surfaceblow. How lucky you came along." Like a drowning sailor reaching for a floating piece of timber, the owner flashed a sickly grin. "Show the inspector the charger, Hugh," he ordered his chief engineer.

"As you were—don't let go the stern lines yet, Mr Smith," bellowed the onetime marine engineer in his gravelly voice, as he hooked his right thumb into the armpit of his vest and blew a few smoke rings into the air. "We're talking about an $80,000 cargo. That's a lot of pea soup. And since I'm not Santa Claus, exactly how much is it worth if I save your crop?"

Pete Smith's eyes widened. He quickly shot an annoyed glance at the two irate brothers, then back at Marmaduke. He was on the hook, and no mistake about it. With that kind of money involved he couldn't talk peanuts.

"Well, that depends," he finally said, stalling for time, as the two Schultz brothers ominously awaited his answer. "It depends on how long it'll take you to get those lift trucks rolling—of course."

"That I don't know," barked the inspector emphatically. "I just got here, and I've never seen your charging equipment. But if I can put it back into business, you'll have those lift trucks charged by tonight. All I want for myself is a thousand clams. And I want to waltz out of here with that green stuff safely anchored in my cargo hold.

continued

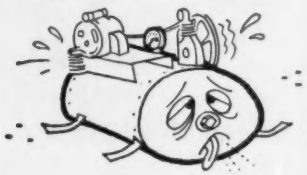
ONE OF A SERIES OF CHATS ABOUT THE CONSERVATION AND CONTROL OF HEAT

SARCO TOPICS

PREVENTION OF CRUELTY TO OLD COMPRESSORS

You've got at least one air compressor, of course. Doesn't everybody? And there it sits, pumping its heart out for you year in and year out. And you there, Simon Legree, do you ever give it a break and measure its capacity?

One measure is the useful work done by your compressed air tools, of course. However, this yard stick may make your compressor installation seem way oversize, but don't blame the equipment. The puffing oldster isn't responsible for choked intake filters, poorly designed suction pipes,



overcooling, undercooling, inadequate distribution mains and wet air. All these things can cost you.

Off and on we're going to talk about compressors in these pages, if you don't mind. It's a big subject and the lesson for today will be confined to the air intake. Can you imagine a more logical place to start?

Where to locate the intake? Easy. Where the atmosphere is clean and cool and dry. Dirty air and grit choke filters and eventually get through to cause wear. The cooler the air, the more you can compress per revolution. You'll get 10% more air delivered at 40°F. than at 90°F. And dryness is imperative, because compressed air can't contain all the moisture it can hold in its uncompressed state. Where does the moisture go? Into mains, tools, and valves, unless it's removed. And need we add that chemical fumes cause corrosion? That includes exhaust gases from engines and furnaces. CO_2 in the presence of oxygen and moisture can rust your valves, tools, nozzles and sprays.

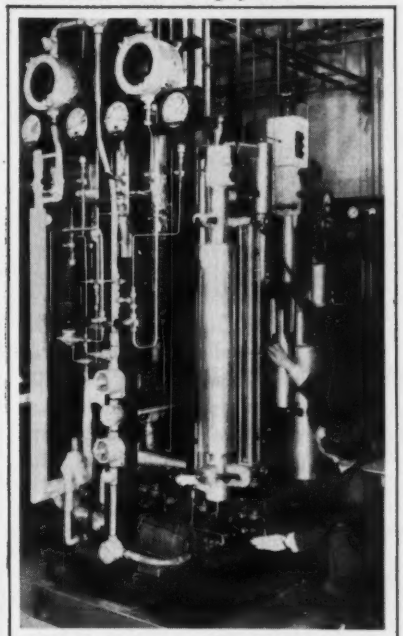
How about intake size? Keep pipes short, sized right, and straight as possible. Small pipes with snaky bends reduce pressure and capacity. For an educated example, a pressure loss due to friction in the intake pipe and filter of 2 psi (14.7 to 12.7) will reduce output of a 125 psi compressor by 7.5%.

How do we know so much? Well, as we continue in future issues, we'll be talking drains and traps and cooling and safety controls for compressors—all of which we manufacture. That's how we know so much. If you can't bear to wait, just write. It's that easy to get information out of us.

SARCO AND THE FLYING DUTCHMAN

In the pipe shop of a major office building complex on New York's east side, the Flying Dutchman flies again. This is really a bright idea which could well become standard practice elsewhere, because it's the kind of logical precaution that would make sense anywhere.

The chap in our photograph is putting together, according to precise, dimensioned drawings, an assembly consisting of a Sarco Thermo-Dynamic Steam Trap, Type TD-50, a Sarco strainer, and valves and fittings for stock. The assemblies will be used for quick and easy replacement in the event of failure or any possible maintenance requirement in the steam distribution system, the heating system, or the air conditioning system.



WORLD'S LARGEST ESPRESSO MACHINE?

No indeedy. It's a pilot plant Hydrofiner unit built by The Lummus Company at its Engineering Development Center in Newark, New Jersey. And its presence here is due to the fifteen ⅜" Sarco Thermo-Dynamic Steam Traps which vent and drain its 35 pound tracer lines plus a ½" TD-50 as a main drip. Nice to be picked for projects like this. Makes us proud.

We'd like to be able to report that this plan recently saved thousands of people from freezing or roasting during a crisis. So far, however, the assemblies have proved to be an ornamental kind of insurance policy. Alas, there have been no failures. That dog-goned Sarco performance is just too reliable for its own good.

WE'VE GOT THINGS TO GIVE AWAY

First of all, we have a new spring clip to hold together a bunch of papers on your desk, or something. It's not complicated, but it *is* difficult to describe, so we've gone to the tremendous expense of having our local Michaelangelo sketch it here. If you have no papers to hold together, it makes a rather delightful snapping noise that might amuse you. Oh yes—it also has a cross section of a TD-50 steam trap printed on it which actually *moves* when you wiggle your eyeballs at it. In case you *still* don't know how a TD-50 works, this is for you.

Second, we've still got engineers' sketch pads which we enjoy giving away so much we're offering them again. In case you're new here (Hello!) they contain isometric grid paper for use by anyone involved in piping or hookup sketches for process or heating applications.

And the famous Sarco key chain, which is really exactly that—a chain—about 60 times as handy as a fat case, we're offering again too. This has a TD-50 replica attached, but detachable. Call it tawdry promotion if you will, but our super-aesthetic wife wears one proudly around her neck.

All of these are available from your Sarco representative. Or, if he's out, write in.

There's really no reason to keep this conversation one-sided. After all, we're both interested in these subjects or you wouldn't have read this far. So write, even if it's only about a difficult problem.

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STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

SARCO

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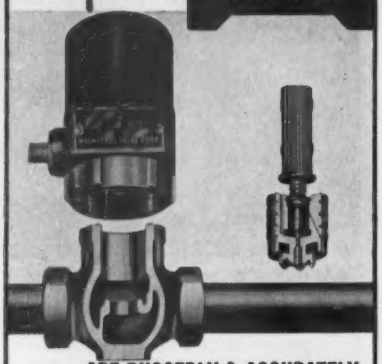
Magnatrol SOLENOID VALVES



. . . ARE RUGGEDLY & ACCURATELY CONSTRUCTED TO GUARD AGAINST COSTLY FLOW FAILURES.

The entire operating mechanism of Magnatrol Solenoid Valves can be cleaned, repaired or replaced WITHOUT removing the valve body from the pipe line or breaking flexible electrical leads.

This unusual design advantage plus the fact that every Magnatrol Valve is CUSTOM ASSEMBLED and FACTORY TESTED . . . means greater dependability.

Available in normally closed and normally open models, in pipe sizes from 1/4" to 3". Pressure ranges from zero up to 500 psi.

Catalog mailed upon request.

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Lay off that blow-off valve

You wouldn't hand fire your boilers, so why blow them that old fashioned way. The Madden System does the complete job automatically — controls solids concentration accurately; recovers practically all the BTU's from the blowdown water; yet requires no maintenance. If you can afford three square feet of space, you can afford the Madden Continuous Blowdown and Heat Recovery System; the savings will pay the initial cost within a year's time. Before you open another blow-off valve write for "Blowdown Low-Down". *The Madden Corporation, 1345 Jarvis Ave., Chicago 26, Ill.*

circle 294 on Reader Service card, p 99

"That's kinda steep. . . ." Pete Smith started to haggle, his Adam's apple doing a violent Mexican jumping act. But that's as far as he got.

"Will you cough up our loss if that crop spoils while you stand here arguing?" barked the bigger of the Schultz brothers, getting pink around the gills.

"OK, you got me over the vinegar barrel," came the inevitable reply. "Take Mr Shylock Surfaceblow to your charging room, Hugh." The four men followed the chief engineer into the building.

In the charging room, Marmy gave the equipment a quick once-over with his observing eye. The m-g charging set consisted of a single rotor with 440-volt 3-phase squirrel-cage motor windings on one end, the dc generator windings on the other. The generator's field poles were self-excited. He saw that the lift-truck batteries were connected to the charger output with a polarized plug.

Marmy quickly checked the polarity and found it reversed. "Just as I thought," was his only comment. He glared at the charger for a moment and then a smile broke across his leathery face. "Everything else looks shipshape, including this charging relay," he observed with great satisfaction. "So it's Christmas after all."

"Now, Chief, you must have at least one good battery stowed away that's at least partly charged and has some zing left in her," he told Dermott.

"We got one spare. Her voltage should be up because she hasn't been used far as I know. But why?" asked Dermott, completely lost.

"Tow in that battery," barked Marmaduke, puffing furiously on his stogie.

A minute later the inspector had the battery connected to the charger. He quickly lifted the generator's carbon brushes, then closed the charging relay for an instant and watched the needle on the voltmeter jump. "Kick her in," he barked at the chief engineer. The chief did, and to everyone's utter surprise, the charger worked. The Schultz brothers slapped each other on the back.

"Well I'll be a flying heifer. What in tarnation did you do to bring her

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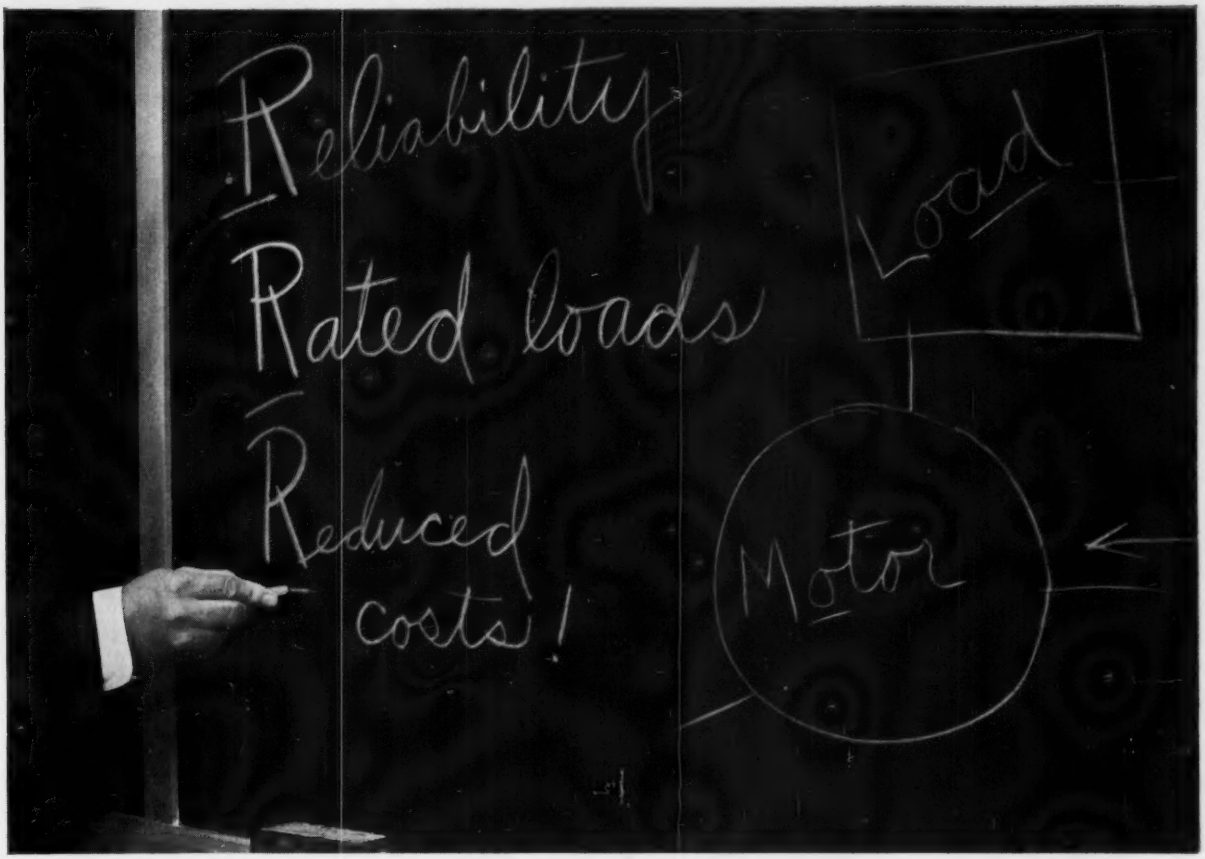

...and you'll specify silicone insulated motors!

Electric motors, properly applied, are about as reliable as any rotating equipment can be. But what does "properly applied" mean? Do the newer motor insulation systems modify long accepted application practices? If so, how? What about reliability? Rated loads? And that old bug-a-boo, costs?

Reliability depends on where a motor is located and what kind of job it's doing. High ambient temperatures and the heat of overloads are handled easily by the high thermal stability of silicone insulation. Fly ash and other airborne contaminants bounce off sealed silicone rubber insulation systems without degrading reliability. Humidity and moisture are taken in stride by coils that have been high potted under water as a production check.

Rated load of driven equipment is frequently the maximum load a motor ever will be called on to deliver. Specifying motors with nameplate horsepower rated for short-term, peak load conditions is being outmoded as too expensive. Today, it's far more economical . . . and just as reliable . . . to specify silicone insulated extra service factor motors with horsepower rating based on nominal load conditions. Additional horsepower output — up to 50 percent above nameplate rating — is available for peak loads because of the excellent thermal stability of silicone insulation.

Reduced costs result from specifying extra service factor motors. Further savings . . . up to 30 percent of initial costs . . . result from specifying open motors with sealed silicone rubber insulation systems instead of motors with elaborate enclosures.

If you have not investigated Dow Corning silicone insulation systems, why not take advantage of the free literature offer below?

"Specify Silicone Insulation . . . and Save" is yours for the asking. Write Dept. 3423, Dow Corning Corporation, Midland, Michigan.

first in silicones

Dow Corning

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ANY SIZE

from ½" to 12" I.D.

STRAIGHT or CURVED

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Illustrated are a few of the many types and sizes of Rotojet Tube Cleaners driven by air, steam or water. We analyze each application before recommending equipment that best meets the requirement.

ELLIOTT COMPANY – ROTO PLANT

Tube Cleaner Specialists Since 1910

1071-53 Bristol Road, Mountainside, N. J.

For more facts circle 297 on Reader Service card, p 99

Marmaduke

Begins on page 138

to life? Well for gosh sakes. . . ." was all the chief could blabber as he scratched his head and looked incredulously from the charger to Marmaduke Surfaceblow.

"I'm no witch doctor and I don't use black magic," roared Marmaduke. "If she didn't have that polarized plug it would have been easy to reverse the battery connections to the charger. But I gave her current through the field poles in the right direction, and the reversed residual magnetism changed in polarity. Now your charger has the correct polarity again, so she works."

The chief quickly hooked the lift-truck batteries to the charger. The owner, Marmaduke and the two Schultz brothers went to the office, while the chief hurried back to his hand truck.

Inside the office the charging continued, only this time in the form of folding money from Smith's safe into Marmy's hot hands. Then the Schultz brothers invited Marmy and Pete Smith to their farm, where they promised a country-style dinner that the inspector wouldn't forget for a long time. "And maybe we can dig up a jug or two of hard cider," winked the bigger of the two brothers, "and throw in a barn dance tonight for good measure. Our Clyde County girls are mighty easy to look at."

To this day, the natives of Clyde County talk about that 1936 pea crop. That was the year the Schultz brothers, the smaller growers, the Clyde County Cold Storage Co and the pea pickers had their biggest year on record. Of course, they'll tell you that the machinery inspector didn't do so badly himself, not for only about five minutes of work. Or was it merely for knowing a few basic fundamentals—the kind every person responsible for expensive power-plant equipment could easily learn about from books or trade magazines, in the first place?

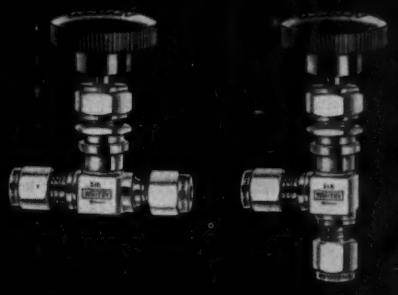
—STEVE ELONKA

EDITOR'S NOTE: *Can you top this story? If so, send it in. If it isn't used for* Marmy, *it may make a* What would you have done? *In either case, if we write a story around your incident you'll receive $15.*

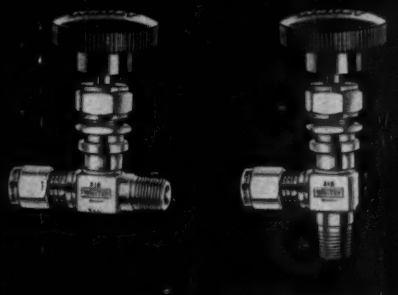
circle 298 on Reader Service card, p 99 ➤

WHITEY MINIATURE VALVES

0 SERIES VALVE



OVS2 OVS2-A



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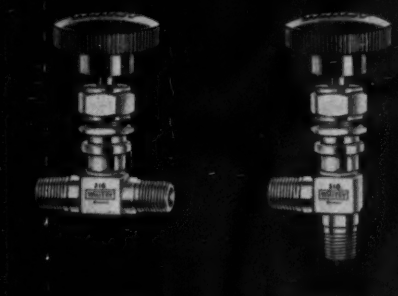
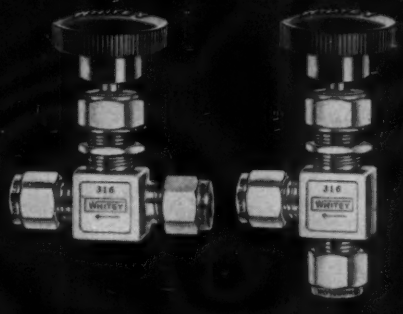
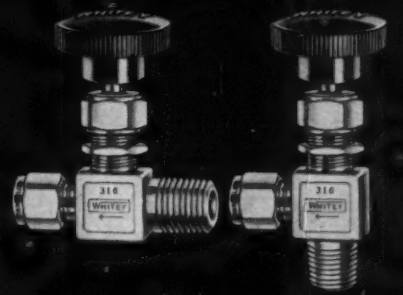


OVM2 OVM2-A

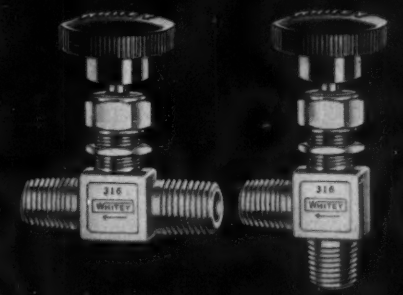
1 SERIES VALVE



1VS4 1VS4-A

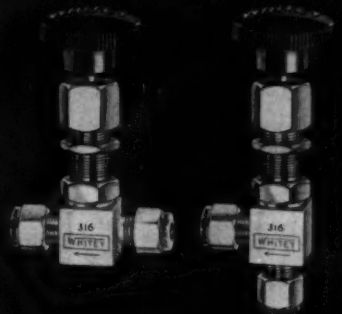


1VM4-S4 1VM4-S4-A

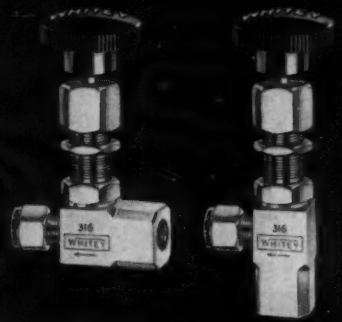


1VM4 1VM4-A

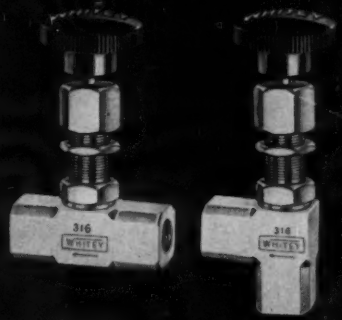
2 SERIES VALVE



2VS4 2VS4-A



2VF4-S4 2VF4-S4-A



2VF4 2VF4-A

WHITEY Research Tool Co. manufactures a complete stock of small valves designed for instrumentation work or any application demanding flawless performance in fluid or pneumatic systems.

The WHITEY Valves above illustrate some of the wide variety of connections available in ⅛" and ¼" pipe and tube sizes. These valves are stocked locally by your WHITEY Distributor.

In answer to customer demand, all WHITEY Valves through ½" size are available with Swagelok Tube Fitting Connections to facilitate ease of installation and positive, leakproof performance. Male and female pipe connections through ½" size are also available.

Panel mounting; Teflon* cylinder packing; micro-regulating and non-regulating stems are standard features on all WHITEY Valves.

For color coding purposes, colored handles may be specified when ordering WHITEY Valves.

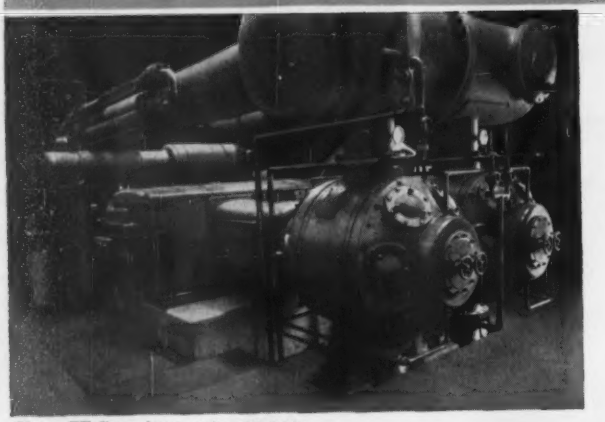
*Dupont

Complete technical data on WHITEY Valves available on request

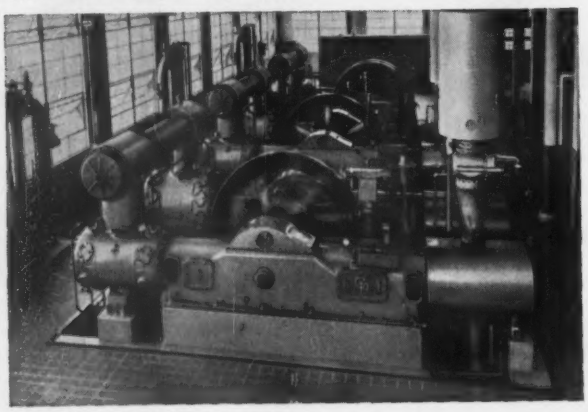
FOR EXACTING SERVICE WHITEY

WHITEY RESEARCH TOOL CO. • 5525 MARSHALL STREET • OAKLAND 8, CALIFORNIA

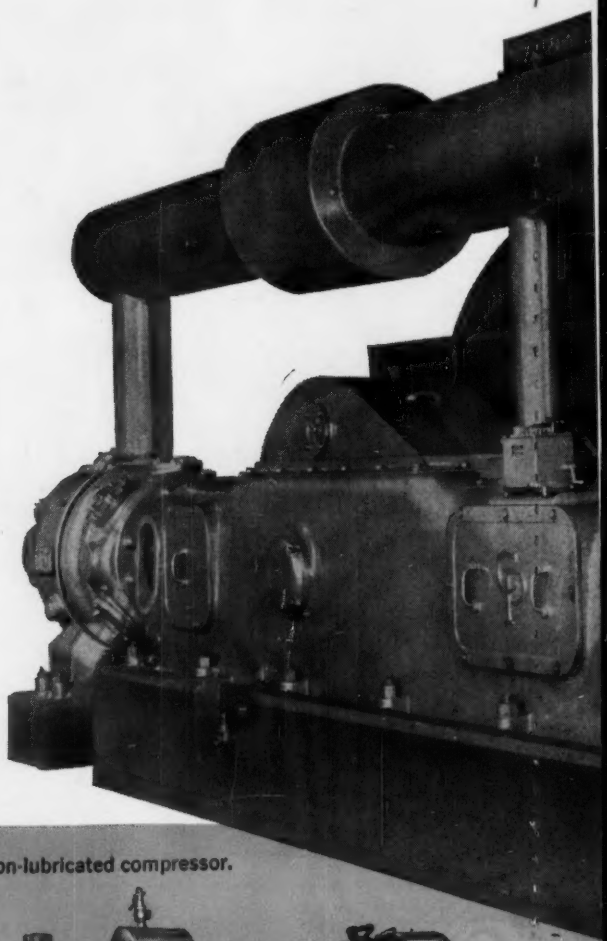
CP LOW SPEED Compressors for the Long Haul



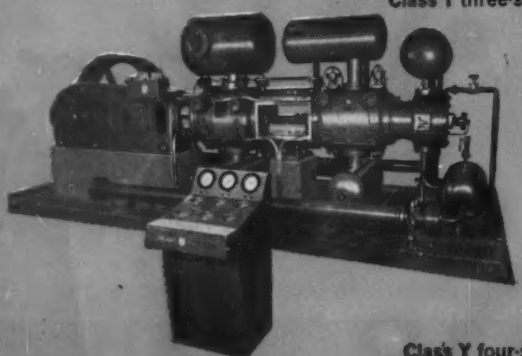
Class FE five-stage compressor.

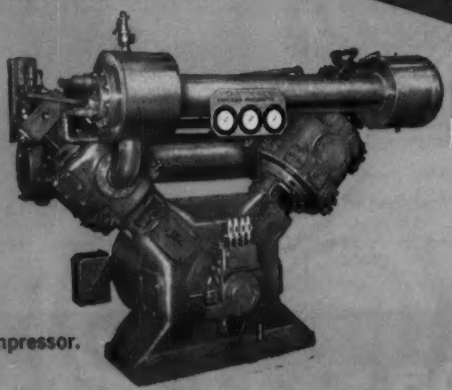


Class H steam-driven compressor.



Class T three-stage, non-lubricated compressor.





Class Y four-stage compressor.

CP's wide variety of compressors include the low speed horizontal duplex, and "four-corner" designs. Simple, sturdy, conservatively rated, they have distinguished themselves for their high efficiency, dependability, low maintenance cost, long life. Available in sizes up to 2,000 horsepower; from one to six stages for pressures up to 15,000 pounds; motor- or steam-driven.

CP also offers a wide choice of other types, tailored to meet specific requirements. They include the Class "T" horizontal, straight-line in sizes to 150 hp; the Class "Y" up to 300 hp; and the Class "FE" horizontal, balanced-opposed in sizes up to 6,000 hp.

Class H-CE horizontal, 4-corner, motor-driven compressor.

Chicago Pneumatic

8 East 44th Street, New York 17, N. Y.

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC AND ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

For more facts circle 299 on Reader Service card, p 99

Powerscope . . . A selective look at

First million-kw unit in sight

Consolidated Edison Company of New York City has ordered world's largest turbine-generator, with expected capability in excess of 1-million kw. Allis-Chalmers will build the unit for a price tag of $131 million, and plans to complete it by early 1966. The 2-shaft cross-compound unit will operate at 2400 psi, 1000/1000 F, 3600/1800 rpm. New turbine-generator and its boilers will go up on a site next to company's East River station on East 14th St, Manhattan. Construction starts in '63. Con Ed's current capacity tops 5000 mw, and the utility ties in to a 40,000-mw power block stretching from Long Island to Quebec.

Largest pumping facilities

Five giant pumps will be used in the nation's first hurricane dam at Providence, R. I. Each vertical-propeller pump will top 20-ft dia, measure some 31 ft end-to-end. Driven by 4500-hp motors, they can handle over 4½ billion gpd in combination — Worthington Corp is building the pumps under a $1.5-million contract awarded by the U.S. Army Corps of Engineers. Fox Point Dam will stretch 680 ft across the Providence River to protect downtown Providence, which is below sea level. Normally the river and tides will flow through three 40-ft river gates. But when hurricanes boil up raging waters, the gates will close to keep the storm tides out. Then the Worthington pumps will reroute the river's overflow into Naragansett Bay.

Fuel cells forge ahead

Natural-gas industry is at work on a cell that turns gas into electricity by chemical reaction. According to Martin Elliott, v-p of Illinois Institute of Technology, the industry is currently studying a fuel cell that uses molten-carbonate electrolyte and operates around 1500 F. They're also researching thin-film solid-electrolyte cells. One 0.8-kw natural-gas fuel cell used together with storage batteries could supply all electricity for the average home, plus heating or cooling. Combined efficiency: 80%.

Ammonia is Allis-Chalmers' latest candidate. Ammonia fuel is economical, they say, and handling techniques have already been worked out. The lab-sized ammonia fuel cell has electrodes of porous carbon, with concentrated potassium hydroxide as electrolyte.

Back-pack power supplies

Navy now has a back-pack 1-man-portable thermoelectric generator. Developed by Westinghouse Electric Corp, the experimental electric plant burns bottled propane gas or can adapt to ordinary gasoline. Solid semiconductor materials convert the gas flame's heat into electricity when a fan maintains the proper temperature difference across them. The generator grosses 340 w; the fan uses 80 of them.

Back-pack thermionic power supplies using fossil fuels will be studied by Atomics International for the Army. They'll be working along a 3-pronged approach, investigating thermionic converters, heat sources and high-temperature materials. The thermionic converter produces electric current by heating an electrode so that electrons boil off and jump to a cooler electrode.

Pump-turbines hold 1200-ft head

Two single-stage reversible pump-turbines will transfer water at night from an underground plant to a reservoir 1200-ft above. That's the highest head so far for single-stage reversibles. English Electric is building the units for North of Scotland Hydro-Electric Board's 400-mw pumped-storage plant on Loch Awe. Units are rated 142,000/136,500 hp.

Air-pollution fight rages ahead

Representatives of San Francisco's pollution-fighting organizations recently toured the Bay Area Air-Pollution Control District, viewing dramatic demonstrations of industry's control efforts. At the Lakeside Junk Company they saw a dense black column of smoke abruptly cut off as a $10,000 multiple-chamber incinerator went into operation. This incinerator reduces pollutant output from 1200 to 100 lb per month. At Titan Metal Manufacturing Company they inspected a $65,000 baghouse installation, which operates like a giant vacuum cleaner, collecting 50 tons of pollutants a year in 1280 special Dacron bags. Using their new equipment, both these companies are now complying fully with regulations.

More ammunition for the fight: a large-scale animal study will attempt to cast some light on pollution's effects on human health. U.S. Public Health Service is giving Detroit's Wayne State U College of Medicine $190,000 to study more than 4000 animals—

this month's power-field happenings

B G A SKROTZKI, Associate Editor

rats, guinea pigs, rabbits and mice. In particular, they're watching lungs, blood and length of life. One-third of the animals will breathe contaminated air pulled in from a busy street. Second group gets normal urban air from the lab—same air the investigators are breathing—while the lucky third lives in a special clean room.

Engineering must build for the future

The profession is going ahead so fast that engineering knowledge becomes obsolete at the rate of 5% a year. So said Dr Richard Folsom, president of Rensselaer Polytechnic, at the New York City dedication of Cooper Union's new Engineering Building. That means that if the graduate doesn't keep on studying, in ten years only half of what he knows will be up-to-date—in 20 years, presumably, he'll know nothing! Solution to the dilemma, says Folsom, is "closer cooperation between study and practice"—continuing education leading to continuing professional development.

Critical manpower guaranteed

A new program aims to make sure vital engineers and scientists aren't snatched out of industry by a wholesale draft during a national emergency. Developed by EJC's Engineering Manpower Commission and the Scientific Manpower Commission, program is called Employer's Inventory of Critical Manpower. Purpose is to insure effective use of technical manpower: help employers analyze their own personnel situation in the light of draft regulations, and give the Selective Service people a balanced order of call so they won't draft essential men in time of emergency.

Gas-turbine packages sold

Greenwood Utilities of Mississippi has ordered a 11,250-kw General Electric packaged gas-turbine power plant. Installed late this year or early in '62, unit will handle peaking and firming system capacity. The plant operates remotely and unattended on dual fuel—gas and distillate oil. It will go in next to the Greenwood-Henderson steam-turbine-generator station and be controlled from there.

First of two 11,300-kw Westinghouse gas-turbine power packages for Sierra Pacific Power Company's Tracy substation north of Reno, Nev. starts up next Nov 15. The twin units are self-contained and controlled automatically. They'll be supplied as turnkeys, installed and ready to go.

Supermagnet is doughnut-sized

Weighing only 1 lb, new magnet creates a field twice as strong as a conventional 20-ton electromagnet as big as an automobile. Westinghouse research people, its originators, think this supermagnet will trigger some far-reaching changes in man's use of electricity. Possible applications: electric generation and distribution equipment, atom-smashing machines, lightweight power plants for space travel. (*McGraw-Hill World News*)

Senate to study fuels and energy

The U.S. needs a coherent policy on how best to use its fuel and energy resources, says Sen Jennings Randolph of W. Va. America can no longer afford the wasteful laissez-faire philosophy of letting all fuels compete as best they can. So the Senate will study the nation's energy, aiming to identify most efficient regional fuel-consumption and energy-use patterns from the point of view of the entire economy.

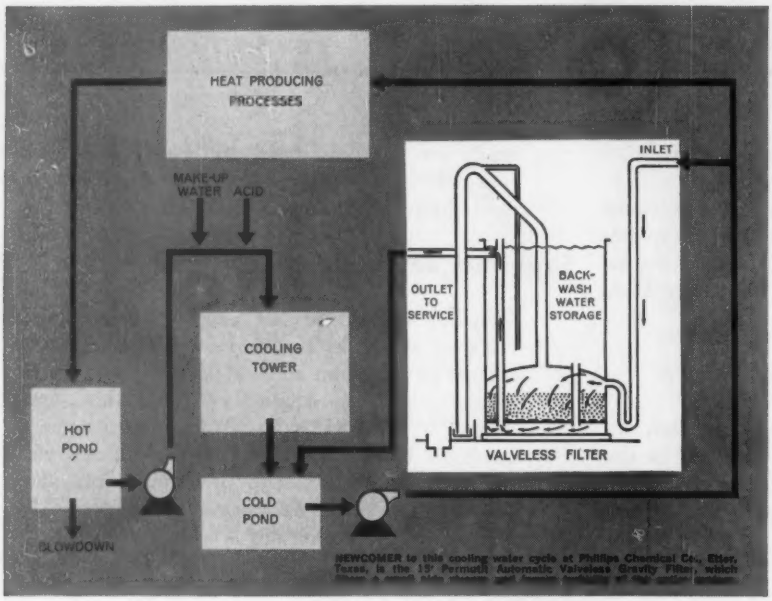
Northwest hydro companies agree

Hydro generating utilities of the Pacific Northwest and Bonneville Power Administration are ready to sign a coordinating agreement. While remaining independent and continuing to control their own systems, the 11 nonfederal utilities will operate all storage and generation on Northwest rivers as if under a single ownership. The 1-year agreement, crowning 15 years' worth of study and negotiation, is considered a pilot plan. If all goes well during the crucial year, a long-term agreement will follow —as it must, if the U.S.-Canadian treaty for joint development of the Columbia River is to work. (*McGraw-Hill World News*)

Chalk up one more plant computer

Central Illinois Public Service Co has ordered a $130,000 analog computer to fully control electric generation and distribution. The Leeds & Northrup computer will be installed at North Pana Station next year, to control output of three steam generators producing 469,000-kw total. In addition, it will regulate interchange of power between Central Illinois Public Service and interconnected utilities. (*McGraw-Hill World News*)

FLUIDICS* AT WORK



NEWCOMER to this cooling water cycle at Phillips Chemical Co., Elter, Texas, is the 13' Permutit Automatic Valveless Gravity Filter, which

New way to shrink yearly maintenance costs—improve heat exchanger operation

Here is a new wrinkle in cooling-tower operation:

Side stream filtration. It can appreciably cut your yearly bill for cleaning fouled heat exchanger surfaces and condenser tubes.

Between the cooling-tower and the heat-exchange operation stands a newcomer to the system—a Permutit® Automatic Valveless Gravity Filter.

Its job is to clean up a small portion of the main cooling water stream, roughly 1% to 5%. By continuously filtering this small side stream the turbidity of all the cooling water is reduced and held to an acceptably low level.

In the system shown here, suspended matter dropped from 2.0 ppm to 0.5 ppm in just one week, and continued to decrease thereafter.

Less turbidity in the cooling water means less fouling of heat exchange equipment. Less fouling, fewer cleanings, more efficient operation.

Costs nothing to operate: To sweeten your savings a little more, the Permutit Valveless Gravity Filter is automatic, in every sense of the word. It operates itself, backwashes itself. Has no moving parts, requires no attendant, no power, no extra pumps. The water used to wash serves as part of the system blow-off—at no extra cost.

Now in use: Proved in this new application, the Permutit Automatic Valveless Gravity Filter is already saving money for several companies.

All you need, to join them, is a little space near your cooling tower, and a Permutit Automatic Valveless Gravity Filter. For more facts, write: Permutit Division, 50 West 44th Street, New York 36, New York.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

PFAUDLER PERMUTIT INC.

A world-wide company with plants in Germany, Great Britain, Canada, Mexico, Japan, as well as the U.S.A.

For more facts circle 300 on Reader Service card, p 99

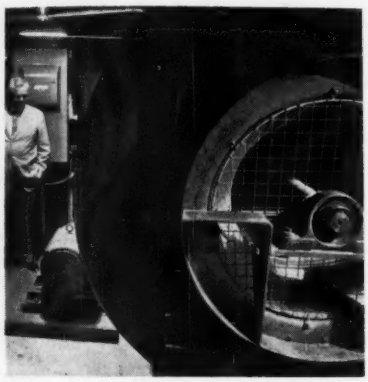
Powerscope

Begins on page 152

Salmon get a ride downstream

With the advent of dams, newly hatched salmon sometimes find their downstream progress halted; this was a conservation problem when Puget Sound Power and Light Company recently constructed a dam across the Baker River in Washington. A fish-transportation system was designed: fish milling about in the reservoir above the dam are collected in a special barge, then pumped down an 8-in.-ID flexible pipe through the face of the dam and released downstream.

Reservoir end of pipe is 70 ft under water and subjected to deep-water pressures. Hewitt-Robins duplicated service conditions for the hose by building a vessel in which water pressures could be regulated. The hose was specified and delivered to the satisfaction of salmon, fishermen, conservationists and Puget Sound Power & Light Company.

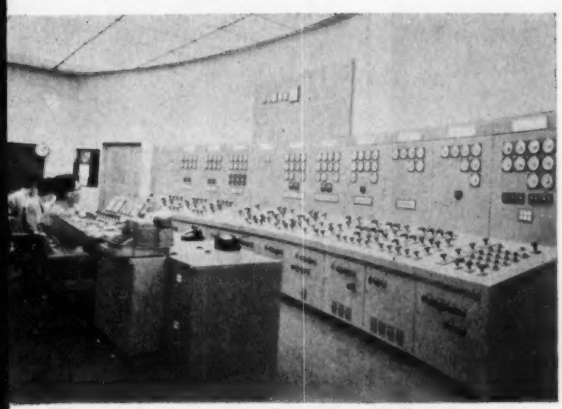


It's always fair weather in this auditorium

New Pittsburgh, Pa. auditorium has a movable, sectionalized roof that opens for performances in fair weather. When it's closed, ventilating system, supplied by the Westinghouse Electric Corp, provides heated or cooled air. System is designed so only that portion of the building in use will be conditioned.

Outdoor air will be drawn in through louvers, pass through filters and under exhibit floor via two main tunnels. Drawn by fans to four main risers, it will then go to the equip-

Another big Hydraulic Turbine and Generator by Hitachi



Switchboard installed at the Miboro Power Station, Central Japan.

Hitachi has recently completed two 137,500 kw/125,000 kVA hydraulic turbines and generators for the Miboro Power Station in Central Japan.

The turbine is of the vertical-shaft Francis type, and specified for a speed of 225 rpm, a maximum effective head of 200 m and 76.6 cu.m/sec water flow, making it one of the largest units of its kind in the world. Its runner has a maximum diameter of 3.7 m and the main shaft a diameter of 95 cm. The spiral casing, which was constructed in 13 sections to facilitate transportation to the site, has an inlet diameter of 3.35 m and an outer diameter of 11.2 m.

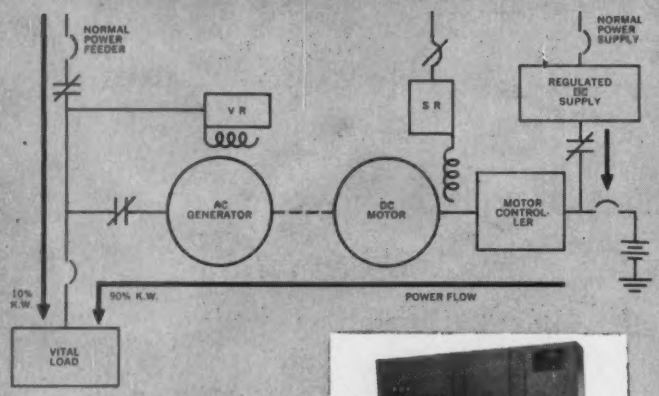
Since the generator was designed for a rated voltage of 16,500 volts and, in this respect, represents the first such attempt in Japan, particular care was taken in the corona-shielding and impulse resistance of the stator winding.

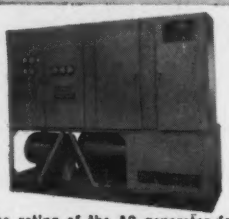
The generator is rated at 60 cycles, 225 rpm and 0.9 power factor but is also capable of operating at 50 cycles, 187.5 rpm and 1.0 power factor.

Hitachi, Ltd.
Tokyo Japan

Cable Address: "HITACHY" TOKYO

For more facts circle 301 on Reader Service card, p 99





The rating of the AC generator for this Kearfott system is 40 KW, 3 phase, 60 cycle, 460 volts.

CONTINUOUS UNVARYING POWER FOR VITAL INSTRUMENTATION IN CHEMICAL PROCESSING

A TYPICAL APPLICATION OF KEARFOTT UNINTERRUPTED POWER SYSTEMS

In chemical processes where even a split-second interruption of computers and related instruments can cause heavy losses, protection against power failure pays high dividends on a relatively modest investment. Take, for example, the Kearfott system pictured here, which assures surge-free entrance of emergency power in zero time in case the normal input varies or fails.

In normal operation, the DC motor runs continuously on power from the static supply, which also keeps the batteries fully charged at all times. The AC generator operates in parallel with the main power and furnishes about 90% of the vital load requirement.

If the main power fails, the DC motor continues to run, drawing its current from the batteries. Simultaneously, the AC generator assumes 100% of the vital load. When main power is restored, the system automatically reverts to normal operation.

Kearfott systems are available with generator ratings to 150 KVA 60 and 400 cycles, single and polyphase, and provide frequency, voltage and transfer regulation as required by the application.

Write for complete data

KEARFOTT DIVISION
GENERAL PRECISION, INC.

Little Falls, New Jersey

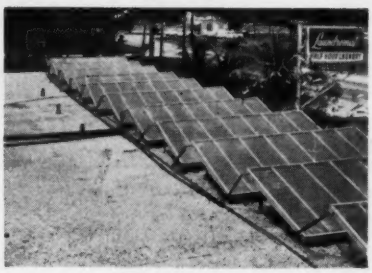
For more facts circle 302 on Reader Service card, p 99

Begins on page 152

ment rooms to be refiltered, heated or chilled, mixed with recirculated air and distributed by ducts into the system's various parts. Centrifugal airfoil fans in equipment room will discharge 280,000 cfm.

Metric system for the U. S.?

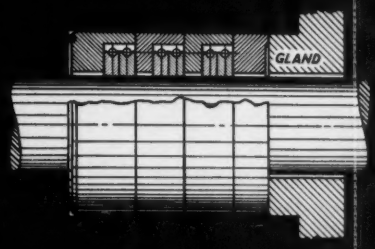
The U. S., which has flirted in the past with the metric system, may actually drop the present in.-lb scale and turn to meters and grams. A House subcommittee has voted $500,000 for a 3-yr study. The appropriation is presently stymied and represents a drop in the bucket compared to probable conversion cost. If change comes, billions of dollars worth of equipment will have to be converted to metric calibration during the next 10 to 30 yr. Some feel gains from compatibility with industry in rest of the world and elimination of conversion between science and engineering labs here would earn back these dollars. Still others feel it would increase foreign trade. The chemical and pharmaceutical industries are making the shift already.



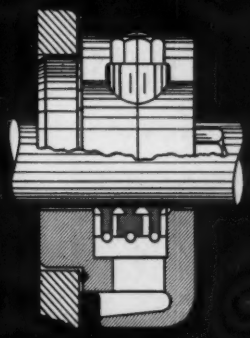
Sun-dry your clothes—with a difference

The sun cuts costs of heating wash water and operating clothes dryers in a Florida laundry. Solar-heating equipment has only one working part, a 1/3-hp pump which operates at a cost of $1 a month for electricity. 12 roof units, each an aluminum frame measuring 4 x 8 ft and 3-in. thick with a glass surface, are basis of the water-heating installation. Each has within it a solid copper sheet or strip in which inflatable

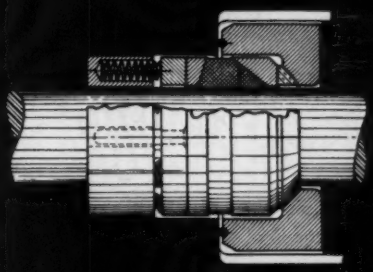
circle 303 on Reader Service card, p 99 ➤



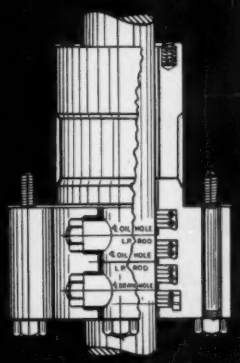
STYLE 308: Solid inside cup. Cannot distort. New rings can be installed with rod in place.



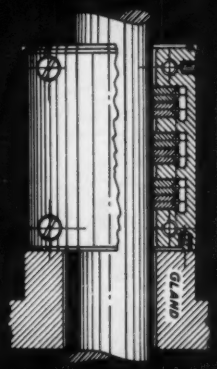
STYLE 128: Bulkhead or splash plate type with bronze rings. Designed to meet any oil condition.



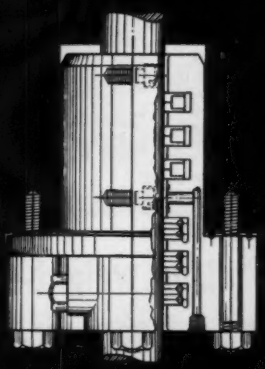
STYLE 141: Solid case type for coreless valve stems. Case can be pushed back.



STYLE 414: Sturdy marine type for medium and low pressure rods and valve stems.



STYLE 316: Widely used type of inside split case.



STYLE 617: Split type, with oil tap, for high pressure and high speeds.

The 6 Machined Metal Packings Specified by Most Engineers

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Yet these are just a few of the many Anchor Machined Metal Packings being supplied. You can be sure—whatever the application—that Anchor can furnish just about any stock or special metal packing that you may need.

Anchor Metal Packings, Machined Type, for use on reciprocating rod applications are made to pack steam, gas, ammonia, CO_2 and many other special conditions at any pressure. Highly refined carbon rings for use on non-lubricated rods and with gases that are corrosive to other packing materials are also available.

For further information on machined metal packings or other Anchor products, see your local Anchor Representative. Or, contact the Anchor General Office in Philadelphia. Ask for your copy of the Anchor catalog.

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FACTORIES . . . MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

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Fast, intermittent trap action . . .

Nicholson weight-operated traps for gas, air, steam and gasoline service

This sectional illustration describes the fast, intermittent action of Nicholson weight-operated traps for pressures up to 1500 lbs. But don't let that float fool you. This trap is float-actuated, not float-operated as are other float-type traps. Here's how this exclusive Nicholson feature works.

When water enters the trap the float rises, eventually *actuating* the weight latch to release the counterweight, which then falls, lifting the discharge valve wide open . . . *instantaneously*. A link latch holds the valve open until discharging water lowers the float, *actuating* the rising counterweight to re-engage the weight latch. The discharge valve is then released by the link latch and closes *instantaneously*.

This rapid, intermittent opening and closing action is a feature you'll find *only* in Nicholson weight-operated traps, including models JR for pressures to 250 lbs., WO and B to 650 lbs., and C to 1500 lbs. Mail coupon for Catalog 500.

W. H. NICHOLSON and CO., 12 Oregon St., Wilkes-Barre, Pa.

Please send Catalog 500 describing Nicholson weight-operated traps for saturated or superheated steam, compressed air and gasoline, oil and gas service.

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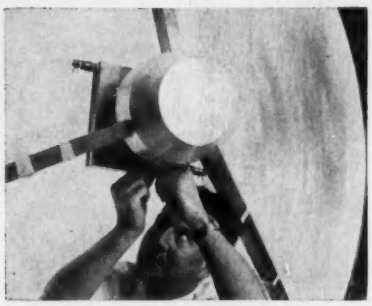
tubing is integral with the metal. Water in tubing is heated by sun's radiation and circulated by a thermostatically controlled pump to the washing machines.

Dryers have heat extractors containing the same copper strip through which water is circulated by a 1/55-hp pump, thermostatically controlled. Water from extractors feeds into the hot-water line which runs from the solar units to a 500-gal storage tank. In this way most of the heat in the hot exhaust air is reclaimed.



Thermoelectricity may provide water

A self-contained electric power plant and pumping unit would make it possible for families in underdeveloped areas to irrigate their own land and supply their water needs. A prototype, including 50-w power plant, has been developed by Westinghouse Electric Corp in cooperation with the Solar Energy Lab of the University of Wisconsin. Thermoelectricity drives an electric motor with a water pump connected directly to it.

A larger solar-thermoelectric system has been operated at part power. Capable of 200 w, it will be able to supply personal needs of 1200 people on a basis of five gal per person per day. This system uses an 8-ft saucer-shaped mirror which gathers sunlight, then focuses it on the thermoelectric generator, a 16-lb metal "box" 2-in. thick with one black face for better heat absorption. Inside there are 72 thermoelectric couples, each composed of one leg of p-type semiconductor material and one of n-type. These generate an electric

National Alfalfa Dehydrating and Milling Company, the World's Largest Alfalfa Processors, has STANDARDIZED on MOGUL water treatment services in 34 plants . . . .

NATIONAL'S network of plants covers the nation's principal alfalfa producing areas. These plants guarantee feed manufacturers a complete range of quality dehydrated alfalfa, available 12 months of the year. When National standardized on MOGUL water treatment and service they gained these important advantages: **obtained maximum water treatment results, full responsibility with one source through the services of the local Mogul Representatives—and reduced treatment costs.** Mogul offers this kind of national service that includes surveys, periodic inspection, consulting service and water analysis. All of these services are supplied free of charge and results are guaranteed. Write for complete information.

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TURBULEX Calciners

Powerscope

Begins on page 152

voltage when heated to a higher temperature on one side than on the other. The couples are connected electrically so their voltages add together. Operating temperature on hot side is 840 F; on cool side, 150 F.

Scientists estimate that during one year, the energy equivalent of 2-billion nominal nuclear bombs moves across latitude 40 in winds. Energy in winds over entire globe at any one time is equal to about 7-million nuclear bombs.

Thermoelectricity protects well from itself

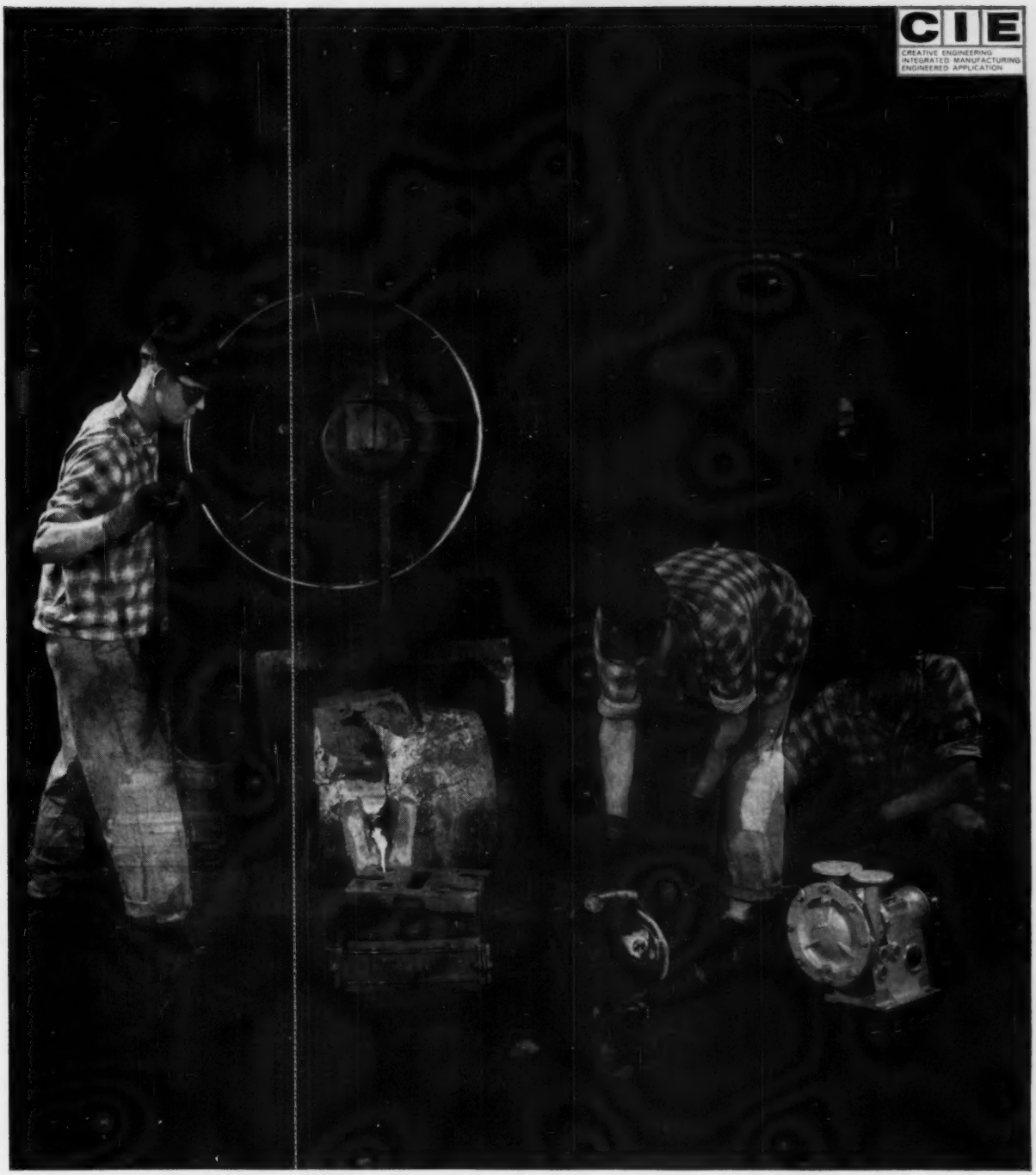
A thermoelectric generator has been put into service to protect a mile-deep gas well of the El Paso Natural Gas Company. Installed in a remote region, it supplies the electric power needed to prevent self-corrosion of the well's steel casing. Cathodic protection utilizes an electrochemical reaction that occurs spontaneously in metal objects buried in the ground. Generator taps a small amount of gas coming from the well, burns it and converts the heat directly into electricity that safeguards the well.

Connected between the 5000-ft well casing and a ground bed of silicon-cast-iron anodes packed vertically in a 200-ft-deep hole, generator reverses the normal flow of current set up by the casing as it chemically reacts with the soil—this way only the ground bed gets eaten away. About six amp at 8-v dc is generated at 800 F on the unit's hot side. Cool side operates at 200 F.

This is a pilot experiment to see if the protective method is feasible for other remote locations.

Potomac Electric Power Co has ordered two giant boilers from The Babcock & Wilcox Co. Together they're capable of generating 5-million lb of steam per hr. Slated for operation in 1964 and '65, they are part of the $105-million 670,000-kw Chalk Point Station to be built in Prince George's County, Md.

circle 306 on Reader Service card, p 99



INTEGRATED MANUFACTURING guides Goulds pumps through the foundry, machine shop and assembly plant to you.

Result? You get a pump that's made to order for the job it must do.

Manufacturing pumps "from foundry to finish" also cuts costs. That's why you get a *better* pump from Goulds—made from high-quality, precision parts—at no greater cost than other pumps.

And, because it's not a mere assembly job, a Goulds pump can be designed and built for interchangeability —to cut your spare parts inventory and maintenance costs.

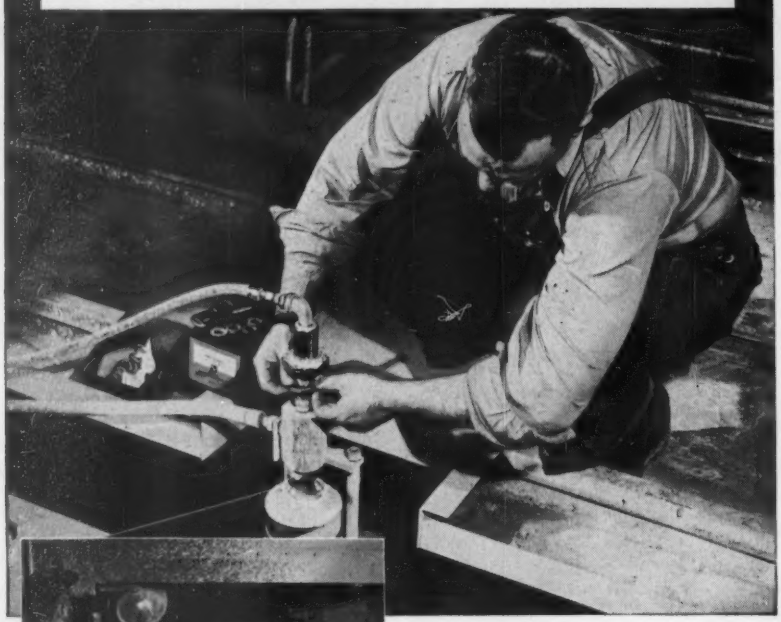
To completely control the production of our designs, we had to build the world's largest plant devoted to the manufacture of pumps exclusively. Over 100 years of experience gives us the know-how.

For help in solving *your* pumping problem, write to Goulds Pumps, Inc., Dept. PO-111, Seneca Falls, N.Y.

GOULDS GP PUMPS

For more facts circle 307 on Reader Service card, p 99

How SEVENeering with R/M eliminated costly packing replacement problem on revolving head spray machine



Switch to new R/M No. 363 Packing Rings increased packing life up to 500%

Poor packing life once was a major cause of a spray painting problem on the acoustical tile production-line at Wood Conversion Company, Cloquet, Minn. The packings in the revolving head spray machines required frequent takeup, were damaged by the water-soluble clay and latex paint, failed in 5-7 days.

In the search for better packings, Wood Conversion Company consulted Modern Distributors, Duluth, Minn., an authorized R/M distributor. R/M No. 363, a new braided asbestos packing with a neutral, graphite-free lubricant, recently introduced by R/M, was recommended. Following tests in its own plant, the company adopted this packing, and with outstanding results.

Packing life has increased as much as 500%, fewer adjustments are needed, shafts wear longer. To sum it up: An R/M packing that costs less than the one it replaced has not only solved a vexatious problem for Wood Conversion Company, but has also brought the big positive advantage of more profitable operations.

The company has been using R/M packings for a number of critical applications, all with complete success.

Call in your nearby authorized R/M packing distributor to help you solve your packing problems. R/M No. 363 may not be the answer in your case, but you can be sure he stocks the right packing to fill your requirements. Learn more about SEVENeering with R/M . . . ask your distributor for a copy of the new R/M Big 7 Packing Selection Chart today.

R/M's Big 7 Packing Types meet 95% of all packing needs, are sold exclusively through authorized R/M distributors

RAYBESTOS-MANHATTAN, INC.
BIG 7 PACKINGS
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

For more facts circle 308 on Reader Service card, p 99

Calendar

Nov 6-8—Technical Conference on Nonlinear Magnetics, sponsored by AIEE, IRE, Statler-Hilton Hotel, Los Angeles, Calif. Details: AIEE, 345 E 47th St, New York 17, N. Y.

Nov 6-9—American Nuclear Society, Atomic Industrial Forum, Annual Winter Meetings and Exhibits, Conrad Hilton Hotel, Chicago, Ill. Details: ANS, 86 E Randolph St, Chicago 1, Ill.

Nov 16 — National Electrical Manufacturers Association, 35th Annual Meeting, The Plaza, New York. Details: NEMA, 155 E 44th St, New York, N. Y.

Nov 26-Dec 1—American Society of Mechanical Engineers, Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y. Details: L S Dennegar, ASME, 345 E 47th St, New York 17, N. Y.

Nov 27-Dec 1—28th Exposition of Chemical Industries, New York Coliseum, New York. Details: E K Stevens, International Exposition Co, 480 Lexington Ave, New York 17, N. Y.

Dec 3-6—American Institute of Chemical Engineers, Meeting. Hotel New Yorker, New York. Details: AIChE, 345 E 47th St, New York 17, N. Y.

Dec 6-8—American Institute of Mining, Metallurgical and Petroleum Engineers, Inc, 19th Electric Furnace Conference, Penn-Sheraton Hotel, Pittsburgh, Pa. Details: AIME, 345 E 47th St, New York 17, N. Y.

Dec 7-9—Canada's Power Show, Queen Elizabeth Bldg, Exhibition Park, Toronto. Details: W J Longeway, 410 Bloor St E, Toronto, Can.

1962

Jan 22-25—National Plant Engineering & Maintenance Show and

circle 309 on Reader Service card, p 99 ▶

CONDENSATE BY-PASS . . . DIRECT ROUTE TO IMPROVED WATER LEVEL INDICATION

Unmistakable water level readings are assured with Diamond's MP-3000 Multi-Port Bi-Color Gauge, equipped with condensate by-pass. A major reason for such performance is the unique and exclusive by-pass which traps any condensate before it reaches the port channel. The absence of condensate in the port channel assures a distinct bi-color image — red for steam, green for water. Regardless of operating pressure, there's a Diamond Gauge to provide accurate water level readings. Write for complete information or contact your local Diamond representative.

Diamond Power Specialty Corporation, Lancaster, Ohio

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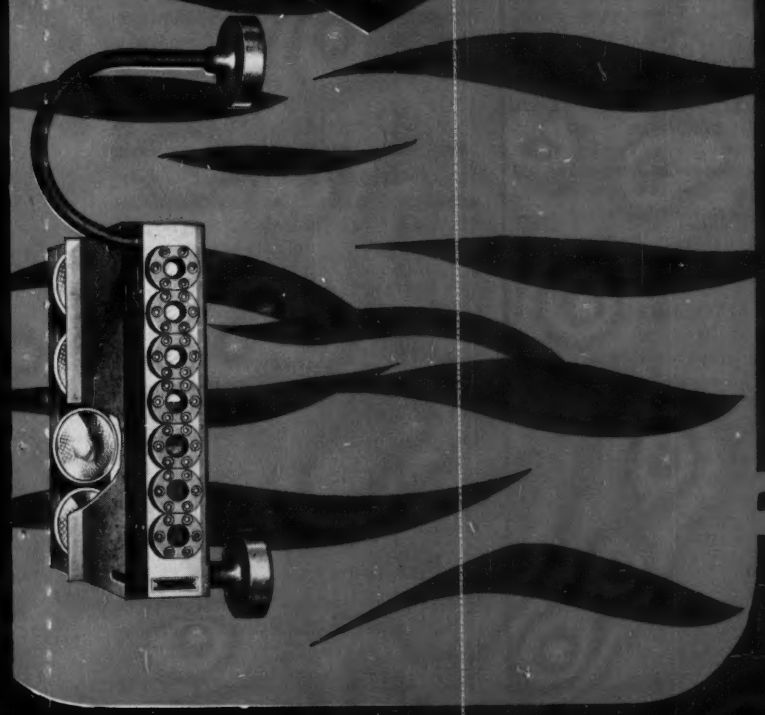
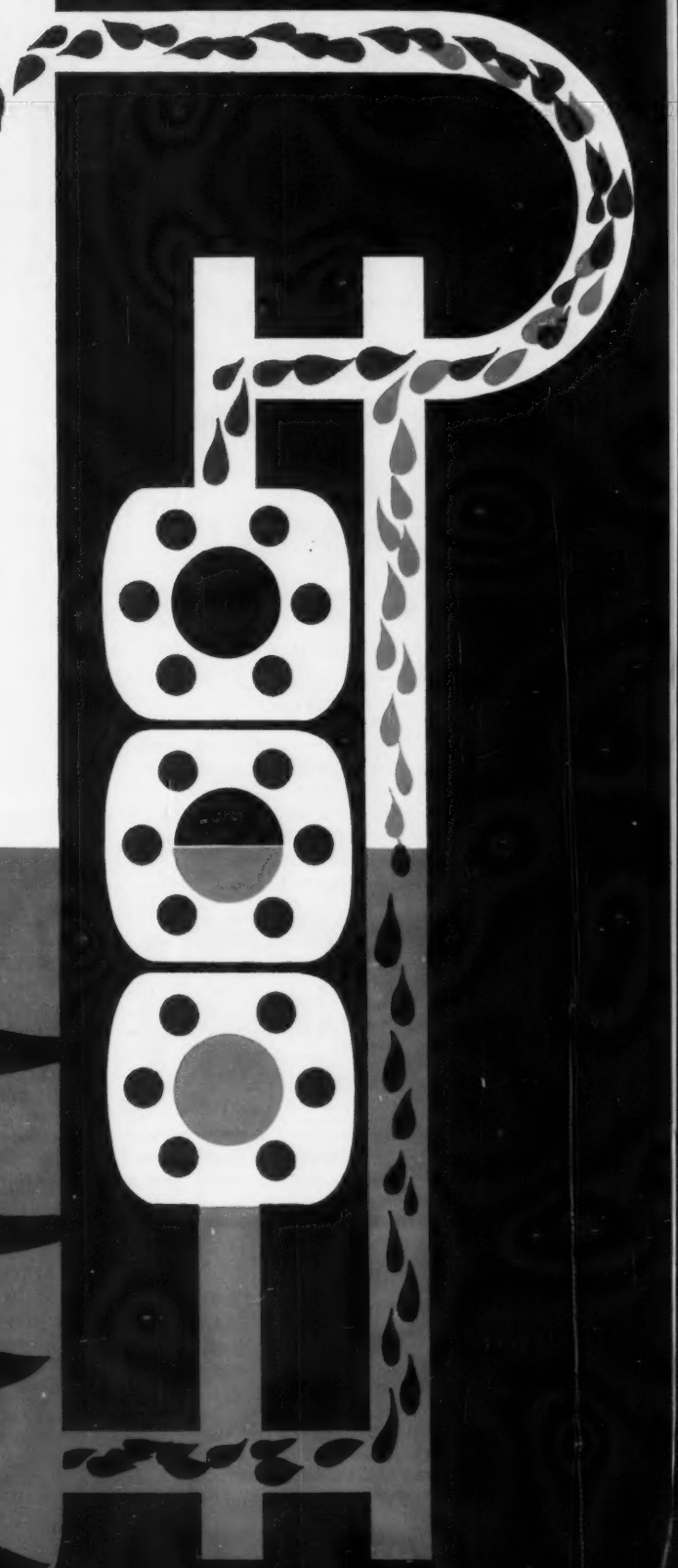
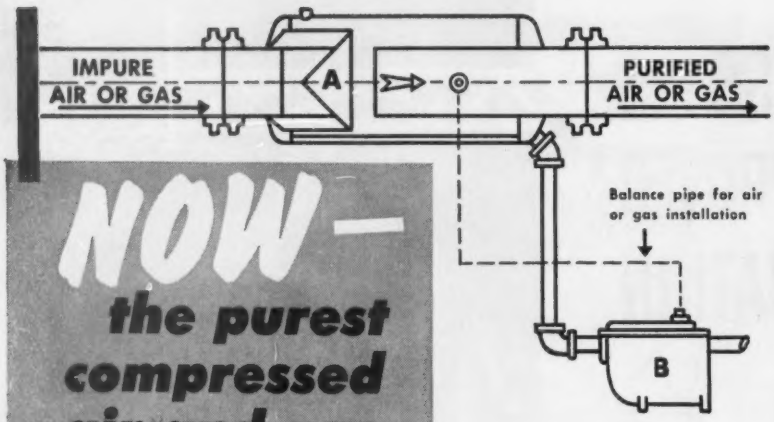




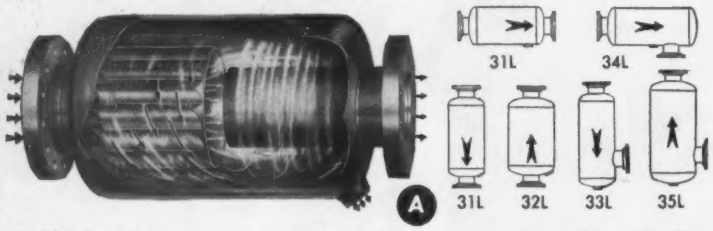


NOW— the purest compressed air and gas is yours with this W-A equipment

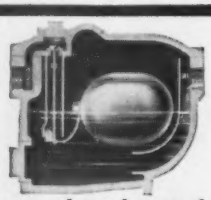
GUARANTEED TO REMOVE 99% OR MORE OF ENTRAINED MOISTURE AND SOLIDS

Where pipe lines carry compressed air and gas, liquids and solids are generally entrained in the gas stream. Wright-Austin 30L Series Separators can be used to remove foreign matter on a wide range of applications. For operating pressures to 5000PSIG. Line sizes to 24". Here are some typical applications:

REMOVE
- —oil and water from compressed air supply lines
- —oil and water on compressed air service at outlet of inter-cooler and after-cooler equipment.
- —oil, moisture and tar between stages in coke oven gas compressors
- —oil and water from CO_2 gas lines
- —oil and water from hydro-carbon lines
- —entrainment from vapor lines following evaporation



This Wright-Austin separator employs centrifugal force to remove impurities from steam, air or gas flow. The pressure drop is extremely low. Type 31N, as well as other models shown, is light weight, compact and sturdily constructed according to ASME code.



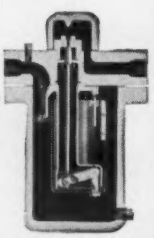
23-AC TRAP (0-125 PSIG)

Separated condensate flows to trap. Drainage is automatic. Particularly adapted where cold, gummy, emulsified cylinder lubricants make ordinary traps inoperative.

B

101-AC TRAP (0-600 PSIG)

Cast steel body, cover and bonnet. Designed for draining condensate where high pressures are involved. Internal mechanism all attached to cover for easy service.



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Calendar

Begins on page 162

Conference, Convention Hall, Philadelphia, Pa. Details: Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.

Jan 24-26—American Society of Mechanical Engineers, Thermophysical Properties Symposium, Princeton U, Princeton, N. J. Details: ASME, Heat Transfer Div, 345 E 47th St, New York 17, N. Y.

Jan 29-Feb 2 — Electrical Engineering Exposition, held in conjunction with AIEE's Winter General Meeting, New York Coliseum. Details: Reber-Friel Co, 117 S 17th St, Philadelphia 3, Pa.

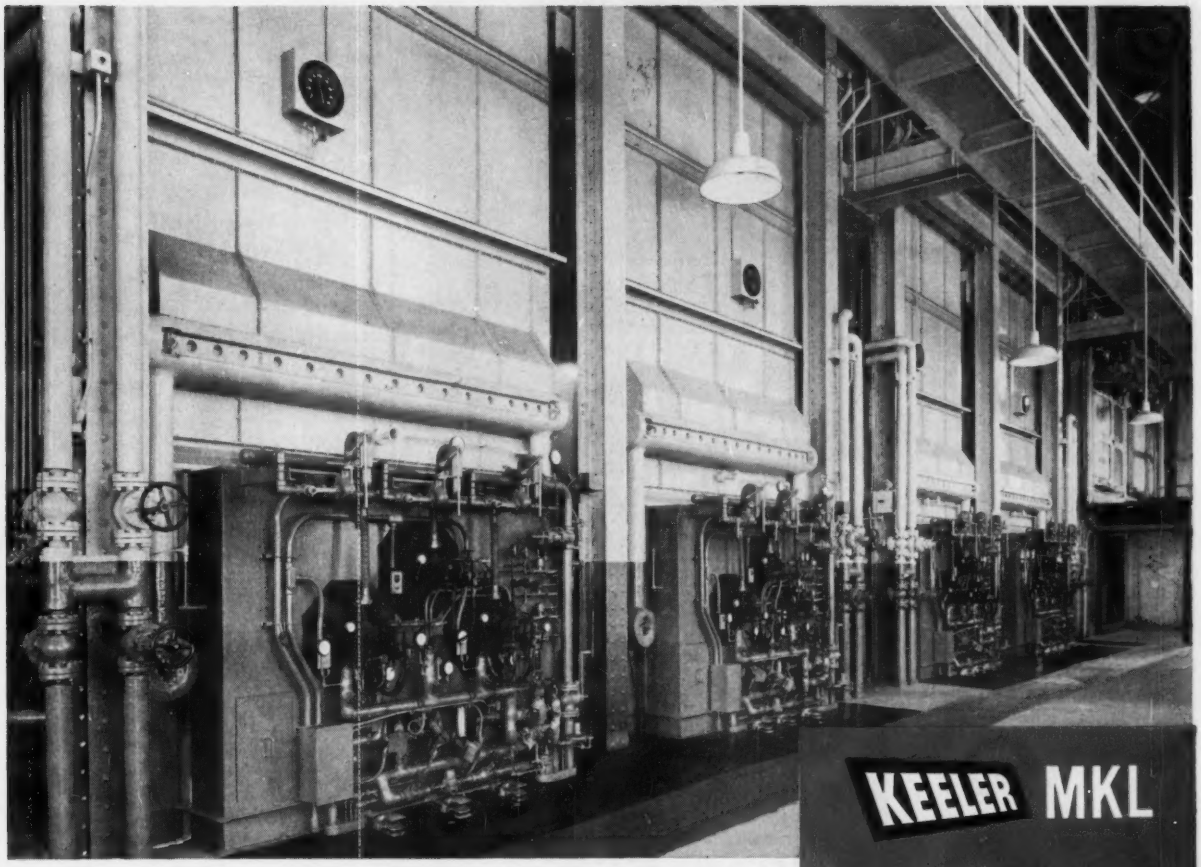
Feb 4-7—American Institute of Chemical Engineers, Meeting, Statler Hotel, Los Angeles, Calif. Details: AIChE, 345 E 47th St, New York 17, N. Y.

Feb 11-17 — National Electrical Week sponsored by electrical-industry groups. Details: NEW Committee, Suite 306, 407 N 8th St, St. Louis, Mo.

Feb 12-15—12th Exposition of the Air-Conditioning, Heating and Refrigeration Industry, sponsored by ARI, Los Angeles Great Western Exhibit Center. Details: ARI, 1346 Conn. Ave, NW, Washington 6, D. C.

Feb 18-22—American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, New York, N. Y. Details: AIME, 345 E 47th St, New York 17, N. Y.

Feb 20—Fourth National Electrical Insulation Conference, sponsored by National Electrical Manufacturers Assn, American Institute of Electrical Engineers, Shoreham Hotel, Washington, D. C. De-



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FOUR KEELER TYPE MKL STEAM GENERATORS EXCEED EFFICIENCY GUARANTEE AT SEARS

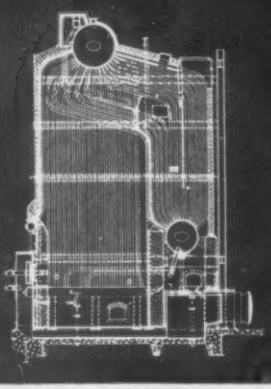
The Sears, Roebuck and Co. mail order plant in Philadelphia encompasses millions of square feet of usable space. The entire steam requirement plus adequate standby is supplied by four quick-response Keeler Type MKL Steam Generators installed in a recent modernization.

Test results have exceeded the guarantee of efficiency and their operation has been *"most satisfactory"!* The new MKL's are 40,000 lb stm/hr combination oil-gas, custom-designed units, 175 psi operating pressure. They were installed in the space previously occupied by four of the six 500-hp boilers which they replaced.

The space and versatility advantages experienced at Sears are typical of Keeler MKL's. The basic design provides true economy and efficiency with quick response to load changes. MKL's are cross drum, bottom supported type available in capacities up to 70,000 lb stm/hr. They're easy to maintain, flexible to space requirements, efficient and durable.

There's a dependable Keeler Water Tube Steam Generator for every requirement . . . from low cost package units to 100,000 lb/hr and field erected units up to 200,000 lb/hr—for all fuels, all types of firing. *Write or phone for complete information . . .*

KEELER MKL



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No. DK-2: Type DK Package Boilers
No. F-14: Type CP Boilers
No. M-2A: Type CPM Package Boilers

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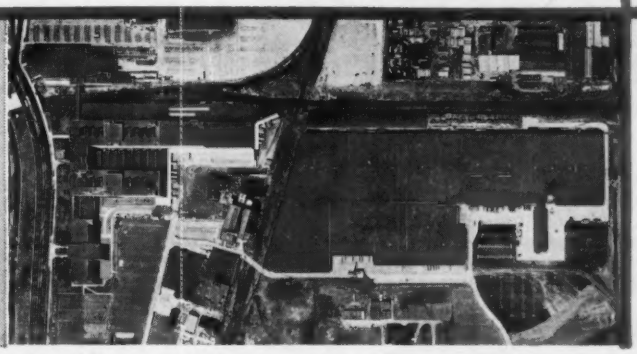
ROEBUCK AND CO.
Mail Order Plant
Philadelphia

The plant serves catalog customers in 8 states and the District of Columbia. Also located here are Sears' eastern territory headquarters offices, a department store, rail and motor freight terminals and warehouses.



KEELER WATER TUBE Boilers

The Seal of Quality in Water Tube Steam Generators

— ESTABLISHED 1864 —

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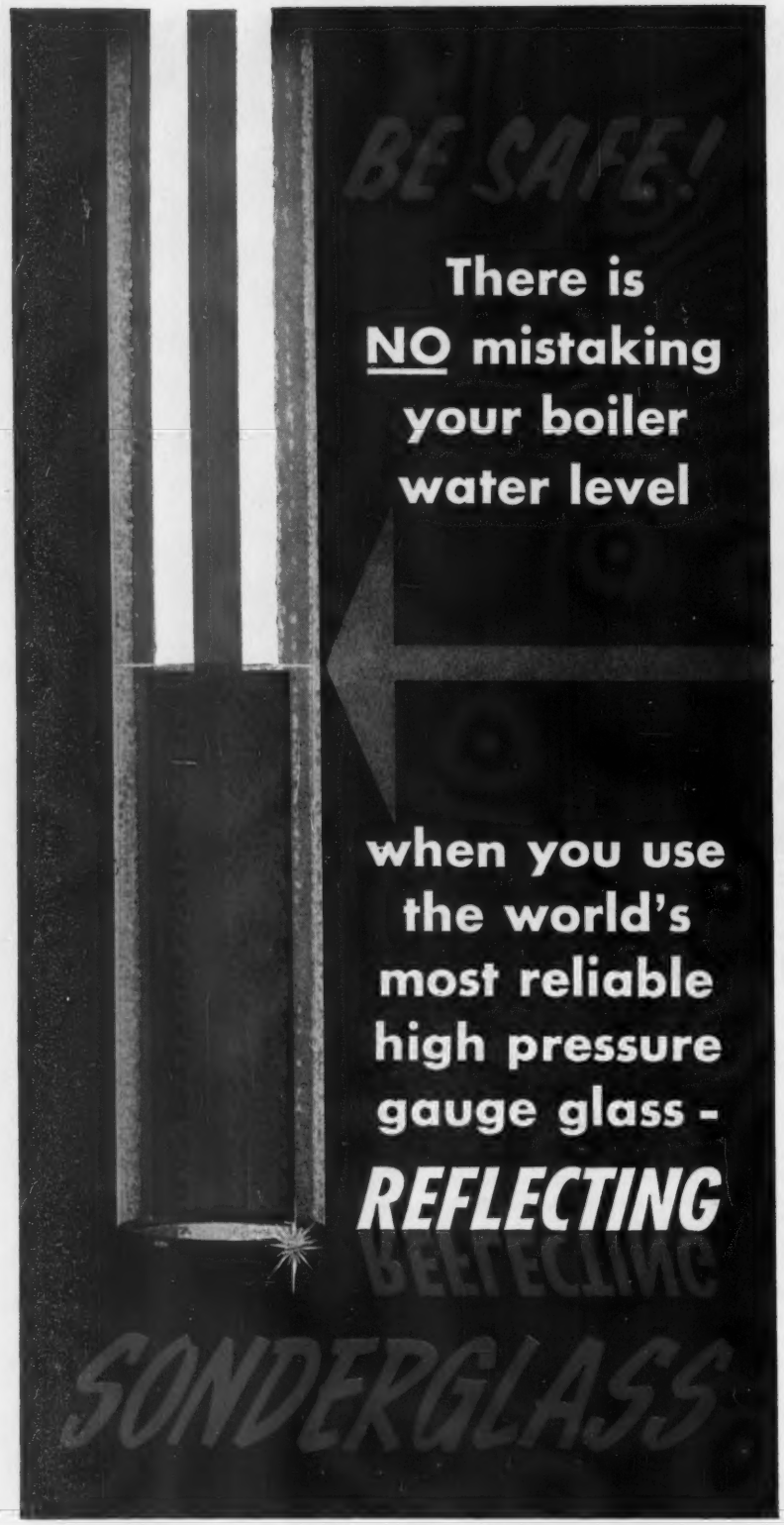


Reflecting SONDERGLASS is the original magnifying redline gauge glass. Its fused double-layer construction resists alkali and acid, remaining clear and easy to read. SONDERGLASS has been tested to upward of 1,000 lbs., per sq. in. steam pressure and 4,000 lbs. hydraulic pressure. It has been subjected to 450° oil baths and repeatedly plunged into cold water without spalling or cracking. Provide your men and boilers with the extra margin of safety by using only SONDERGLASS. Sold by leading industrial distributors.

A. W. CHESTERTON CO., Everett 49, Massachusetts

For more facts circle 312 on Reader Service card, p 99

Calendar

Begins on page 162

tails: R Gingles, NEMA, 155 E 44th St, New York 17, N. Y.

March 4-8—Gas Turbine-Process Industries Conference, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex. Details: ASME, 345 E 47th St, New York 17, N. Y.

March 14-16—Instrument Society of America, 12th Annual Conference on Instrumentation for the Iron & Steel Industry, Hotel Roosevelt, Pittsburgh. Details: H M Gravatt, Allegheny Ludlum Steel Corp, Research Lab, Brackenridge, Pa.

March 19-23 – National Association of Corrosion Engineers, 18th Annual Conference and Corrosion Show, Municipal Auditorium, Kansas City, Mo. Details: T J Hull, NACE, 1061 M&M Bldg, Houston 2, Tex.

March 20-29—American Chemical Society, 141st National Meeting, Washington, D. C. Details: ACS, 733 Third Ave, New York, N. Y.

March 27-29—American Power Conference, Sherman Hotel, Chicago, Ill. Details: ASME, 345 E 47th St, New York 17, N. Y.

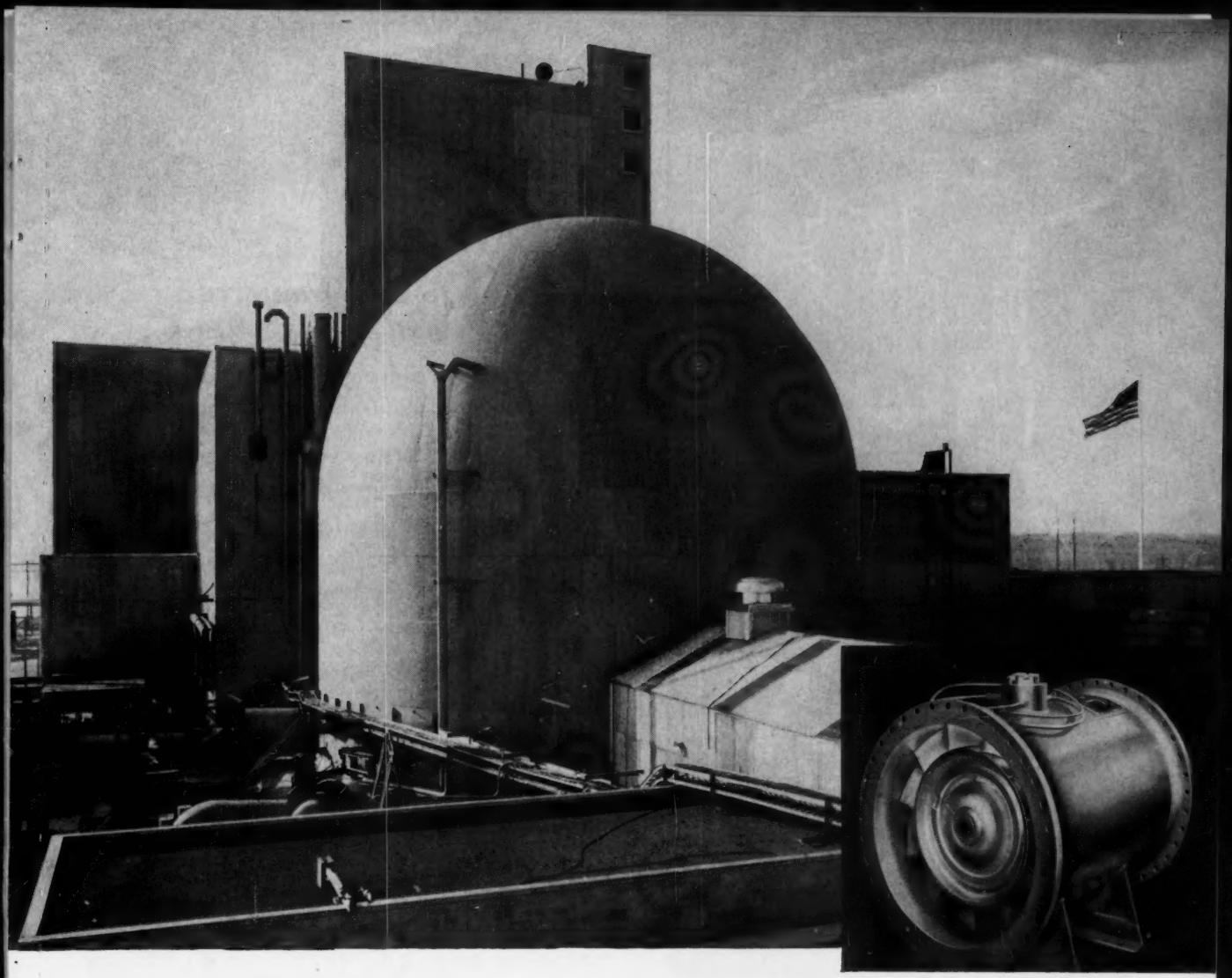
March 28-31 — 11th Biennial Electrical Industry Show, sponsored by Electrical Maintenance Engineers Assn of Calif., Shrine Exposition Hall, Los Angeles. Details: F Tabery, 3443 S Hill St, Los Angeles 7, Calif.

April 5-6 — Management Engineering Conference, American Society of Mechanical Engineers, Society for Advancement of Management, Statler Hilton Hotel, New York, N. Y. Details: ASME, 345 E 47th St, New York 17, N. Y.

April 9-12—24th National Oil Heat and Air Conditioning Exposition, National Oil Fuel Inst, Conrad Hilton Hotel, Chicago, Ill.

continued on page 169

circle 313 on Reader Service card, p 99 ➤



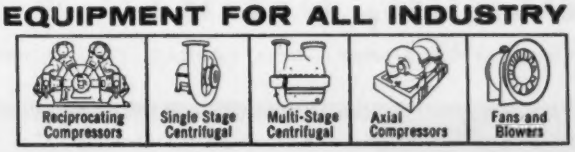
Two-stage JOY Axivane® Fans provide lower vessel ventilation at Enrico Fermi Atomic Power Plant

A special two-stage Joy Axivane Fan circulates the enclosed nitrogen atmosphere which provides lower vessel cooling for the world's largest fast neutron breeder reactor. Rated at 100,000 KW, the Enrico Fermi plant built by Power Reactor Development Company and The Detroit Edison Company will be among the largest atomic power plants in operation. In addition to handling the critical lower vessel cooling, Joy also provided the heavy duty fan for dilution of stack gas.

Joy Axivane Fans are ruggedly built to meet the most demanding service requirements. Power consumption is held to a minimum, because Joy Axivane Fans have adjustable pitch blades which can be set for any desired volume of air over a wide range. Drive motors can always be operated at their most efficient speed. To conserve space and cut installation costs, these fans can be mounted directly in the duct—motors are integral. V-Belt drive is available if desired.

Whenever you need heavy duty, economical ventilation fans, consult your Joy representative. For complete information on Joy fans, write for Bulletin 2549-16.

AIR MOVING EQUIPMENT FOR ALL INDUSTRY



JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

Why Did We Stamp LIMITED on That Valve?

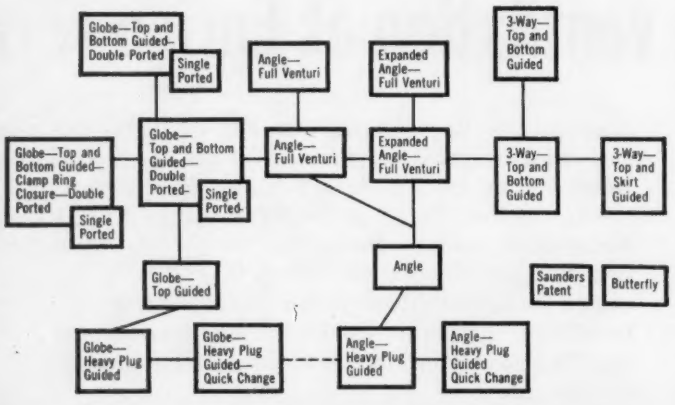
The answer is simple. It's because our control valves **are** limited to **specialized jobs.**

And, why not? When you need a valve you are only concerned that it fits the job at hand, and that it satisfies the process requirement. Each of our valves is designed to do one specific job and do it well. Isn't that what you really want in a control valve?

Take our SUPER 70 line – outlined below. With the many specialized valves and the variety available to you through a selection of internals and accessories, no line can offer you more. In this line you can find the one valve which is **limited** to the job you want done.

If this concept of control valve service makes sense to you, call or write us today.

The Super 70 Family of Valves



BSB

BLACK, SIVALLS & BRYSON

TULSA • OKLAHOMA CITY • KANSAS CITY • EDMONTON • THE HAGUE

Calendar

Begins on page 162

Details: NOFI, 60 E 42nd St, New York 17, N. Y.

April 9-11—American Institute of Mining, Metallurgical and Petroleum Engineers, 45th National Open Hearth and Blast Furnace, Coke Oven and Raw Materials Conference, Sheraton-Cadillac Hotel, Detroit, Mich. Details: AIME, 345 E 47th St, New York 17, N. Y.

April 9-13—Metals Engineering Conference, American Society of Mechanical Engineers, Sheraton Cleveland Hotel, Cleveland, Ohio. Details: ASME, 345 E 47th St, New York 17, N. Y.

April 15-19—Oil and Gas Power Conference and Exhibit, Shoreham Hotel, Washington, D. C. Details: ASME, 345 E 47th St, New York 17, N. Y.

April 25-29—Western Space Age Industries and Engineering Exposition and Conference, Cow Palace, San Francisco. Details: Lykke-Wilkin & Assoc, 681 Market St, San Francisco 5, Calif.

April 26-27 — Nucleonics Heat Transfer Conference, sponsored by ASME Nucleonics Heat Transfer Committee, Argonne National Lab, Chicago, Ill. Details: A E Galson, 211 E Fayette St, Syracuse 2, N. Y.

April 30-May 2 — 8th National Symposium on Instrumental Methods of Analysis, Instrument Society of America, Daniel Boone Hotel, Charleston, W Va. Details: M D Weiss, Special Instrumentation Dept, Union Carbide Olefins Co, South Charleston, W Va.

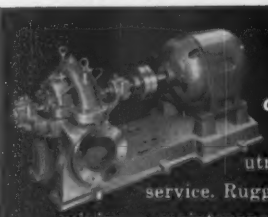
April 30-May 3—Design Engineering Conference and Show, American Society of Mechanical Engineers, Chicago Exposition Center, Chicago, Ill. Details: ASME, 345 E 47th St, New York 17, N. Y.

A Westinghouse V-2 Disconnecting Switch advantage to you:
Teflon-coated bushings on live-side loaded bearings are almost frictionless, resist corrosion, never need lubrication, assure long life and less maintenance

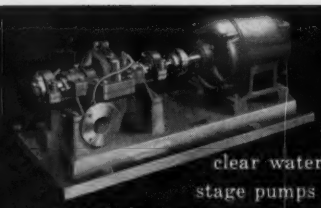
For complete facts on V-2 disconnecting switches, contact your Westinghouse representative or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.
You can be sure . . . if it's **Westinghouse**
J-61016

circle 314 on Reader Service card, p 99

For more facts circle 315 on Reader Service card, p 99

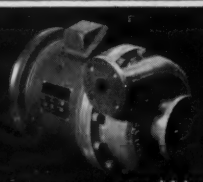


Clear Water Pumps—Double suction pumps designed for utmost efficiency in clear water service. Ruggedly built for dependability, minimum maintenance and down time. Send for Bulletin 955.



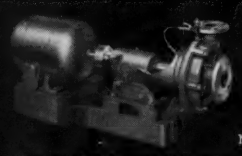
High Pressure Pumps—Ideal for boiler feed and other severe clear water service. These multi-stage pumps operate against heads to 1500 ft. Capacities to 900 gpm. For complete facts, write for Bulletin 980.

Close-Coupled Pumps—These efficient pumps save space, simplify installation. No need for shaft alignment. Vertical or horizontal models. Adjustable discharge angle. Write for Bulletin 975.



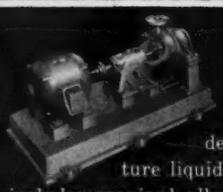
NEW! 'Buffalo' Hermetic Pumps—Quality pumps with special bearings for use where leakage would be dangerous or costly. Available in a broad range of materials of construction. Write for full details.

Non-Clogging Pumps—Move high consistency liquids dependably and efficiently. Minimize wear and wedging. Inspection simplified by diagonally split shell. Rubber-lined models for moving abrasive or corrosive liquids. Send for Bulletin 953.



Chemical Liquid Pumps—Specially designed for moving most corrosive abrasive or high consistency liquids. Your choice of many types in a variety of trim. Will withstand punishing conditions. Write for Bulletin 976.

GPL*



Heat Transfer Pumps—These special 'Buffalo' Pumps are designed to handle high temperature liquids. Job-engineered construction includes required alloys, water-cooled bearings and proper packings. Single suction, solid shell design gives peak efficiency. Write for complete details.

*** True long-range pump economy depends on GPL (Gallons Per Lifetime)...pumped day-in-and-day-out with a minimum of down-time and maintenance costs. This is the kind of long-lived reliability built into every 'Buffalo' Pump. It is the most important result of top quality design and construction.**

'Buffalo' offers a complete line of centrifugal pumps featuring parts interchangeability and low maintenance. Whatever your liquid moving needs, chances are there's a 'Buffalo' Pump to fit it perfectly. And your 'Buffalo' resident engineer is the man to recommend it. Contact him, or write us direct.

"Buffalo" PUMPS

BUFFALO PUMPS DIVISION

BUFFALO FORGE COMPANY

Buffalo, New York

Canada Pumps Ltd., Kitchener, Ontario

'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

Appointments

Awards

Dr I M Stein, Leeds & Northrup Co: Lifetime Honorary Member of Instrument Society of America. **W A Summers,** Ebasco Services Inc: Philip T Sprague Award of ISA. **S B Griscom,** Westinghouse Electric Corp: William M Habirshaw Award of American Institute of Electrical Engineers. **T A Rich,** General Electric Co: Morris E Leeds Award of AIEE. **Dr G Weiss,** Polytechnic Inst of Brooklyn: CompuDyne Foundation in Industry Scholarship of Foundation for Instrumentation, Education and Research.

Consultants

Daniel J Saunders, formerly with Pfaudler Permutit Inc, has opened a consulting office for companies manufacturing engineered products — at 70 Pine St, New York 5, N. Y.

Engineer changes

Philadelphia Electric Co: J H Harlow, chief engineer—engineering and research dept; F J Berger, chief mechanical engineer. **Western Gear Corp**, Industrial Products Div: R W Whelan, chief engineer. **Worthington Corp,** Harrison Div: G W Soete, chief engineer—centrifugal pumps. **General Kinetics Corp:** T M Goike, chief engineer.

General managers

Worthington Corp, Standard Pump Div: P L McManus. **General Electric Co:** R S Baker—computer center. **Westinghouse Electric Corp,** Steam Div: D W R Morgan, Jr—new steam system engineering dept. **SKF Industries, Inc,** Automotive Products Div: E C McGinley.

General sales managers

Imperial Electric Co: E A Kitsch. **Magnion, Inc:** A J Donius. **Micro Systems, Inc:** H A Nielsen. **TRW Computers Co,** Div of Thompson Ramo Wooldridge Inc: R J Stanish. **Milton Roy Co,** Instrument Div:

A Westinghouse Metal-Clad Switchgear advantage to you:

Hinged arc chute simplifies inspection and maintenance of DH breaker

For complete facts on Westinghouse metal-clad switchgear using DH magnetic air circuit breakers, contact your Westinghouse representative or write to Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.
You can be sure . . . if it's **Westinghouse**

J-61017

For more facts circle 317 on Reader Service card, p 99

The MARSH way is the SURE way–

You'll have a new conception of how *uniformly good* radiator valves, traps and vents can perform when you make the job Marsh all the way through.

Take the Radiator Valve and Trap illustrated here, for instance:

The Marsh Radiator Valve is *truly* packless—not just *called* packless. This valve has no "packing" whatever... instead, the ingenious Marsh annular mechanical seal that keeps it drip tight throughout its far longer life.

And Marsh Radiator Traps are equally sure-footed... have the famous Marsh Diaphragm—extremely rugged, but so sensitive that it never fails to close tight on steam, yet opens instantly to pass condensate and air at only a few degrees below closing temperature.

Yes, the Marsh way is the sure way...Valves, Traps, Vents, F & T Traps, designed, built and tested to give lasting satisfaction in the Marsh tradition. Ask for up-to-date Heating Specialties Catalog 76-H.

MARSH INSTRUMENT COMPANY
Dept. F, Skokie, Illinois
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103rd St. Edmonton, Alberta, Canada.
Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas.
Eastern Seaboard Warehouse: Marsh Instrument Company, 1209 Anderson Ave., Fort Lee, N.J.

MARSH *Heating Specialties*
SINCE 1865

For more facts circle 318 on Reader Service card, p 99

Begins on page 171

H R Smith; Mechanical Products Div: A W Lubbers. **Western Gear Corp,** Industrial Products Div: J B Post—engineered products. **Tuthill Pump Co,** Fill-Rite Div: O G Mahnensmith. **Babcock & Wilcox Co,** Boiler Div: J D Hitch Jr—international sales.

Management changes

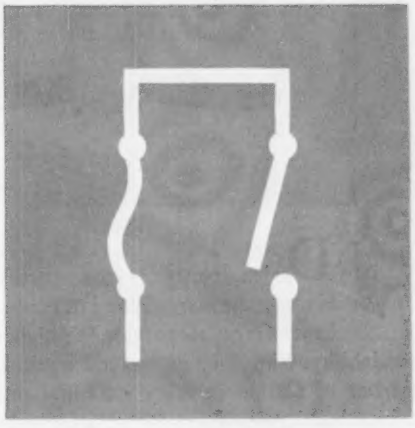
Central Vermont Public Service Corp: A A Cree, board chairman and chief executive officer; H L Durgin, president. **Control Data Corp:** W C Norris, chairman of the board and president. **General Electric Co:** G L Phillippe, president; C W LaPierre, executive vice-president. **Texas Instruments Inc:** M Shepherd Jr, executive vice-president. **Borg-Warner Corp:** L G Porter, president.

T O Schrader Jr

Lack of space has prevented an earlier report of appointments announced by Frank G Brinig, president of the **Erie City Iron Works,** Erie, Pa., manufacturer of steam-generating equipment. T O Schrader Jr, former sales manager, is now executive vice-president; T E Hammond has advanced from assistant sales manager to sales manager; and R F Lindsay is now assistant sales manager.

continued

A Westinghouse Switchgear advantage to you:
DFS drawout switch and fuse switchgear is design-proved in Westinghouse high power laboratory to assure maximum service reliability



For complete facts on DFS drawout switch and fuse switchgear, contact your Westinghouse representative or write to Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.
You can be sure . . . if it's **Westinghouse**
J-61018

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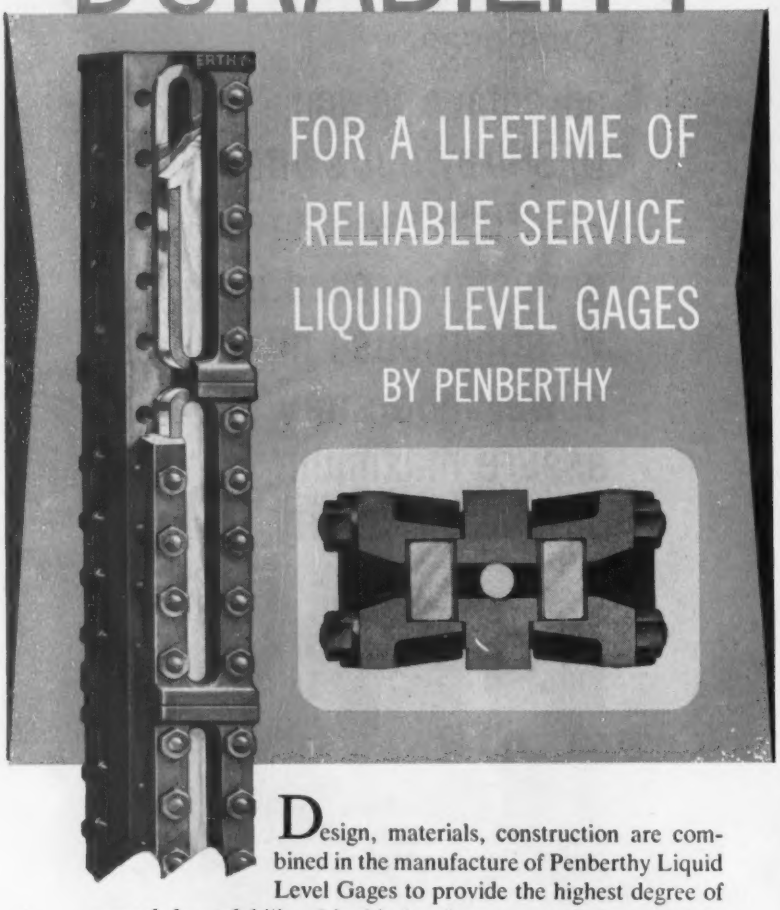
DURABILITY



Design, materials, construction are combined in the manufacture of Penberthy Liquid Level Gages to provide the highest degree of rugged dependability. Liquid chambers are made in one piece from a solid bar of carbon or alloy steel and precision heat treated, machined and ground . . . for perfect, leak-tight alignment and rigidity. Covers, of temperature resistant steel, completely enclose sides and ends of glass and gasket . . . for blowout prevention. Pyrex glass is used exclusively . . . for its greater strength and resistance to shock and erosion. Even the gasket material is specially selected . . . for its high resiliency and ability to withstand excessive compression. In brief . . . For *lasting* accuracy in a liquid level gage, look to Penberthy.

PENBERTHY MANUFACTURING COMPANY
Division of Buffalo-Eclipse Corporation
PROPHETSTOWN, ILLINOIS
SALES OFFICE: 2660 E. GRAND BLVD., DETROIT 11, MICH.

PENBERTHY®
Dedicated to Quality Since 1886

LOOK TO PENBERTHY FOR JET PUMPS, TOO

WRITE OR CALL PENBERTHY TODAY FOR COMPLETE INFORMATION

For more facts circle 320 on Reader Service card, p 99

Appointments

Begins on page 171

New names

Airtrol Div: new division of Robbins & Myers, Inc. **HP Associates:** new affiliate of Hewlett-Packard Co to engage in solid-state research and development. **Burns and Roe Argentina,** Sociedad Anonima: new South American subsidiary of Burns and Roe, Inc. **American Society for Testing and Materials:** name change for American Society for Testing Materials. **Martin-Marietta Corp:** name for consolidated Martin and American-Marietta Companies. **Jordan Valve Div:** formerly OPW-Jordan and now a div of Richards Industries, Inc.

Recent moves

United Engineering Center now houses 19 engineering organizations, with room for more in the future. This is the largest concentration of professional engineering societies in the Free World.

The societies relocated at the new 20-story $12-million building on United Nations Plaza after half a century in their old Engineering Societies Bldg. The old building was opened in 1906 and was made possible by a gift from Andrew Carnegie. New address: 345 E 47th St, New York 17, N. Y.

Elion Instruments, Inc has moved to new plant on Rt 130, Burlington, N. J. **Dynel, Inc** occupies new building at 12923 S Spring St, Los Angeles, Calif. **Photomation, Inc** has relocated to Polaris and Wright Ave, Mountain View, Calif. **Multi-Amp Electronic Corp's** new address is 61 Myrtle St, Cranford, N. J. **Engineers Incorporated** moved to 20 Mt Pleasant Ave, Newark 4, N. J. **Fluor-Singmaster & Bryer, Inc's** new quarters are at 100 Park Ave, New York, N. Y.

Retirements

Roy C Ingersoll, chairman of the board of Borg-Warner Corp. He is succeeded by Robert S Ingersoll.

Charles R Landrigan, Detroit Edison Co executive vice-president, after almost 49 years with the company.

DE LAVAL

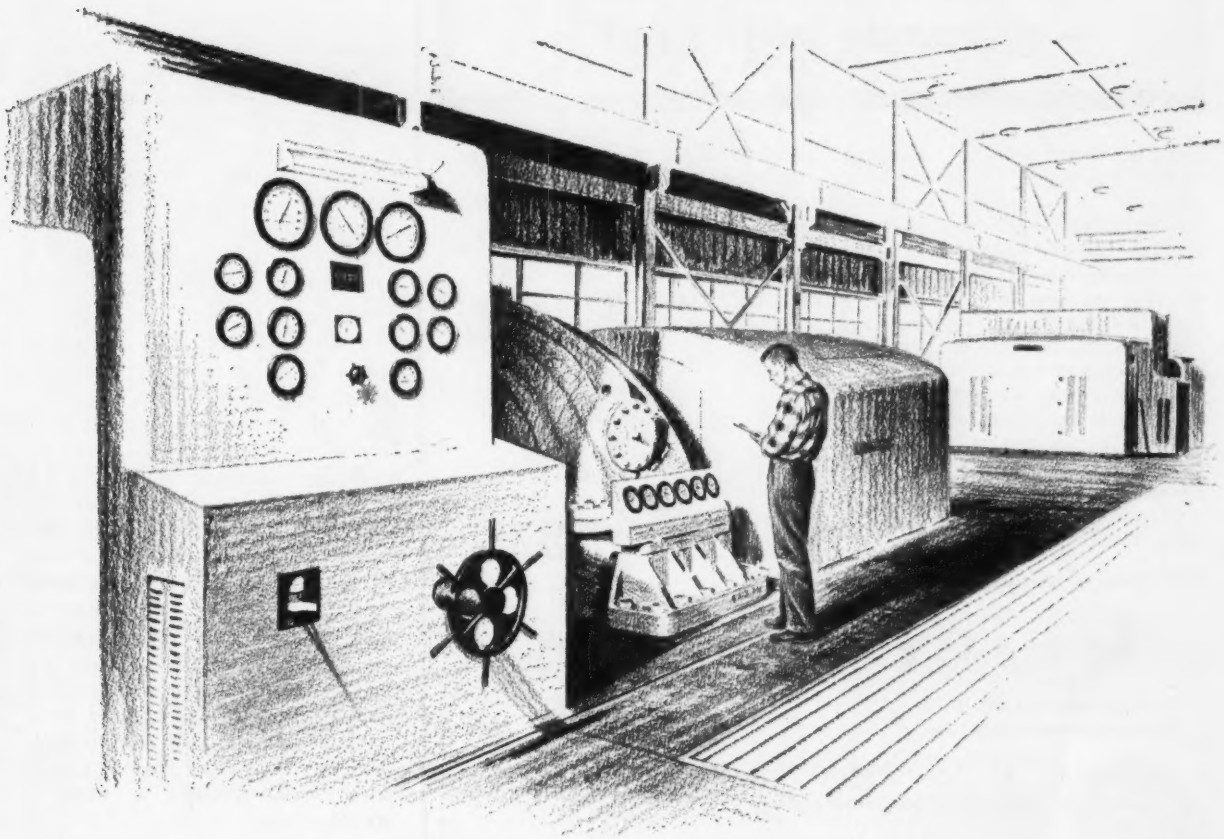
turbines provide power for Colorado-Ute

Laramore, Douglass and Popham, Consulting Engineers, handle Nucla project for Colorado-Ute and Western Colorado Power Company

Three De Laval turbine-generator units are on the line at the Nucla plant of the Colorado-Ute Electric Association, Inc., which is operated by the Western Colorado Power Company, a public utility serving urban centers of the area under an agreement between the two firms. Each of these De Laval AIEE-ASME Preferred Standard Units delivers 12,650 kw. Steam pressure is 600 psig at 825 F; exhaust pressure is 27½ ins. HgAbs.

De Laval application engineers will gladly give you more information on turbine generator units to suit your specific needs or write for bulletin TU-4200.

De Laval Steam Turbine Company, Trenton 2, N. J.



TU-DL-100

DE LAVAL · 60 YEARS OF CREATIVITY AND QUALITY

CENTRIFUGAL PUMPS AND COMPRESSORS • TURBINES • IMO® ROTARY PUMPS AND HYDRAULIC MOTORS
MARINE PROPULSION AND AUXILIARY EQUIPMENT • HELICAL AND EPICYCLIC GEARS • TURBOCHARGERS

For more facts circle 321 on Reader Service card, p 99

New Conveyor Design

—cuts maintenance!
—extends belt life!

Here is a new and entirely different type of belt conveyor. The secret of its amazingly improved efficiency is in the cradle idler, which consists of 5" rubber rollers, assembled on precision-ground ball bearings, prelubricated, and lifetime sealed. The rollers are suspended in a true catenary on flexible, nonrotating stainless steel wire rope, which cannot corrode. Because the wire rope does not rotate, it cannot twist and cause loping, dangerous harmonics, and undue belt wear.

The wire rope is supported at each end by a simple ball joint, so it is free to move in any direction, permitting the belt to adjust itself to any profile. The true catenary suspension provides uniform belt support without bends or creases. *Thus belt life is substantially increased.*

THE CABLE DOES NOT ROTATE!

Write Today for Complete Information

McNALLY · PITTSBURG

McNally Pittsburg Mfg. Corp.
Dept. PO, Pittsburg, Kansas

☐ Please send information on the new McNally Pittsburg belt conveyor.

☐ Have Sales Engineer call for further consultation.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

Bookshelf

Elements of Heat Transfer, 3rd edition. *By M Jakob (deceased) and G A Hawkins, Dean of Engineering, Purdue University. 317 pp, illust, tables, cloth. $6.75. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

As in previous editions, this book emphasizes basic principles and their application in simple problems. It begins by giving fundamental modes of heat transfer followed by their combinations, continues to feature examples of application.

This third edition features a new table on thermal conductivity of liquid metals, added section on equivalent circuits, information on one type of thermal analyzer, additional material on analysis of engineering systems, new section on heat-exchanger-effectiveness ratio, expanded chapter on heat transfer in condensing and boiling, section on gas radiation, new coverage of mass and heat-transfer similarities.

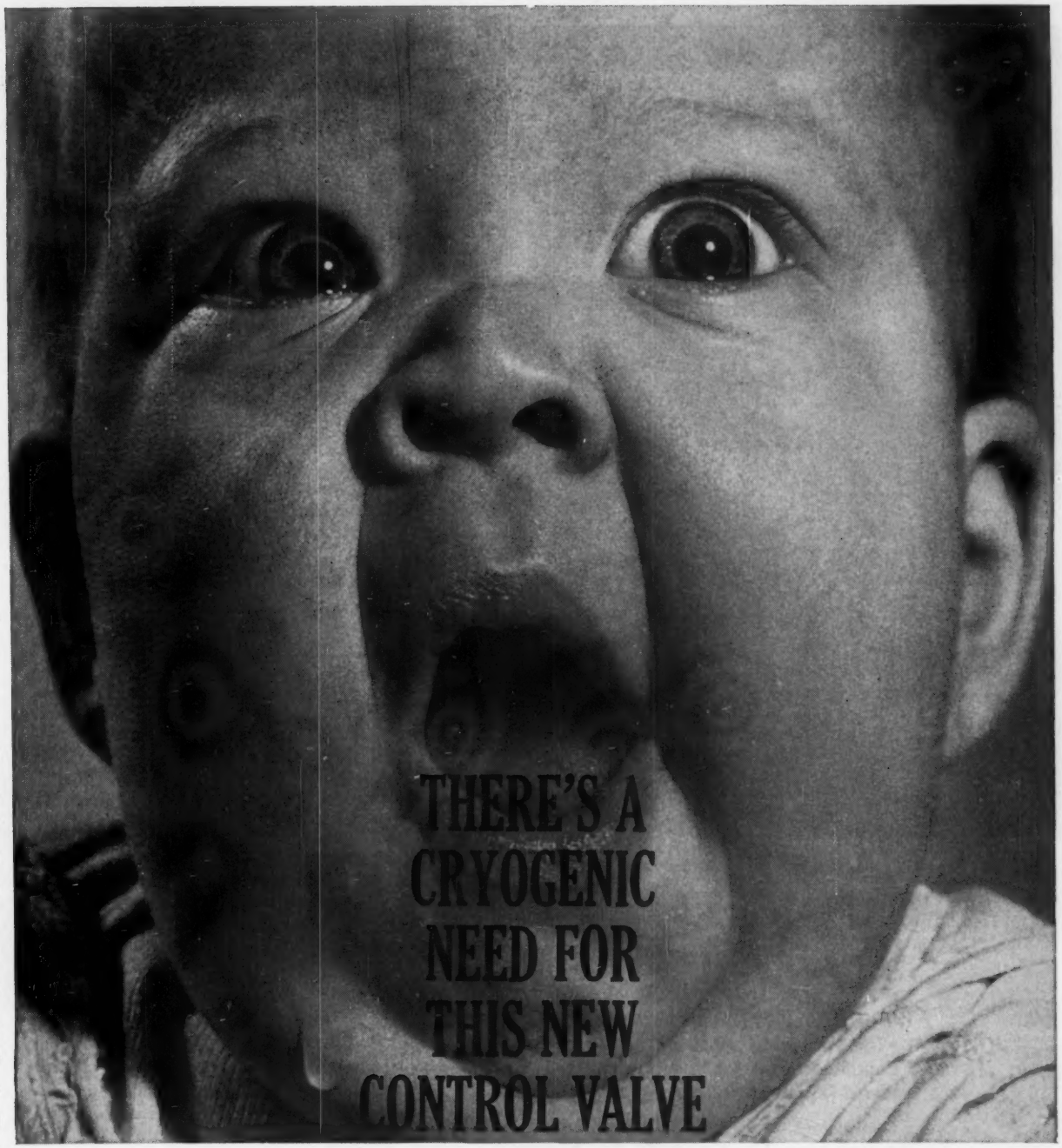
Nondestructive Testing. *By W J McGonnagle, Associate Physicist, Argonne National Laboratory. 455 pp, illust, cloth, $15. McGraw-Hill Book Company, 330 W 42nd St, New York 36, N.Y.*

This book brings together practical methods and the scientific principles on which NDT is based. It explains in detail the what, why, how, when and where of this subject.

Author ranges broadly over his field, from visual testing, pressure and leak testing and liquid penetrant inspection, to thermal methods, dynamic testing and thickness measurement. A feature: discussions of the pros and cons of X-ray radiography, gamma radiography, ultrasonics and magnetic, electric, eddy-current and other methods as working tools.

In treating the field as a technology based on applied physics, author pays special attention to work in atomic energy.

Domestic and Commercial Oil Burners, Installation and Servicing. *By C H Burkhardt, Managing Director, Oil-Heat Institute of America. 416 pp, 6 x 9, 358 illust, cloth,*



Welcome news—a throttling control valve that *doesn't* leak . . . even in cryogenic systems where extremely wide variations in temperature between start-up and defrost distort ordinary valves. This new Leslie Cage Trim design does away with seat ring threads and gasket crush problems—provides tight closing and service life unequalled by split-body or conventional globe type valves.

Solve another problem, too—speed in inspections. The valve can be completely disassembled in *minutes* from the top end without taking the valve body off the line. *Note:* Like all the other Control Valves in Leslie's complete line of single and double-seated types, it is easily adaptable at any time to changes in your system requirements.

For cryogenics, the new valve is available in ½″ to 4″ bronze or aluminum and ½″ to 2″ stainless steel; welding, flanged or screwed ends. For *standard* applications, the same basic design is offered at attractive prices in steel, stainless steel and alloy steel. Write today for further information, and engineering data.

TRADE LESLIE MARK

LESLIE REGULATORS AND CONTROLLERS
A SINGLE STANDARD OF QUALITY SINCE 1900
Leslie Co., 701 Grant Avenue, Lyndhurst, New Jersey

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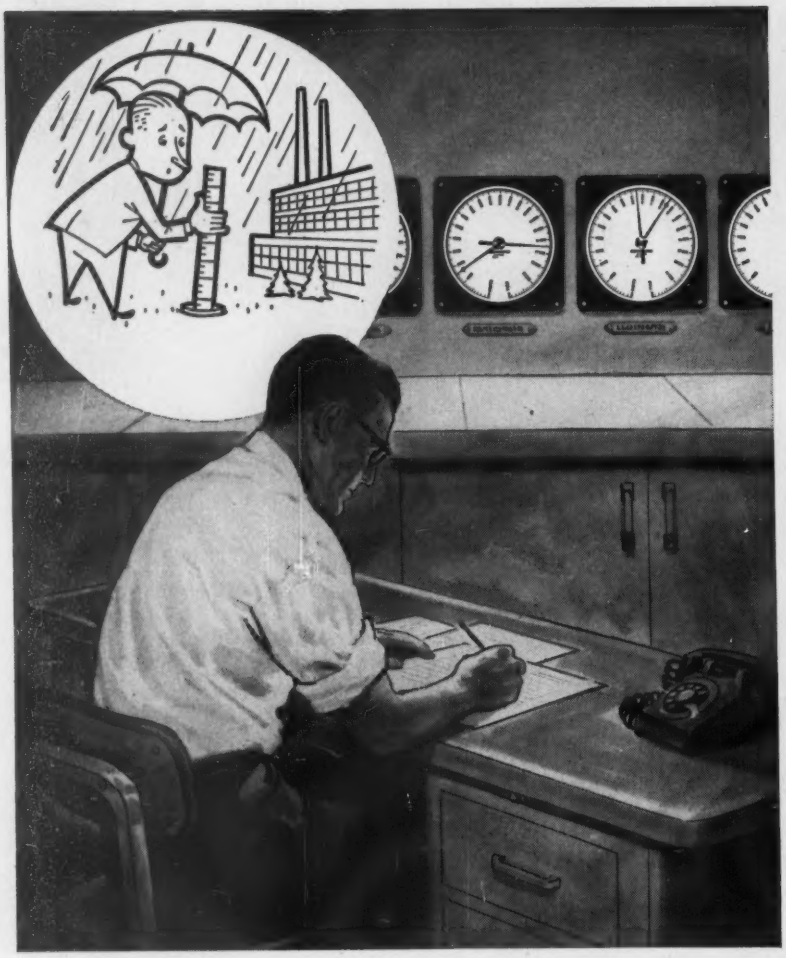


Take the legwork out of liquid measurement

Here's practical liquid measuring—the modern way... without roaming all over the lot! Liquidometer Gauges let you inventory distantly stored liquids at a glance.

Completely automatic Liquidometer Gauges can be located as far as 250 feet from tanks. Think what this centralized system can mean in man-hours saved—let alone the additional safety of personnel who no longer have to trudge to, or tamper with, hard-to-get-at tanks.

Simple to install, and requiring no maintenance, Liquidometer Gauges measure virtually all liquids conveniently, continuously, and correctly. There's a type available for practically every liquid measuring application.

For complete details, write

LIQUIDOMETER INSTRUMENTS

THE LIQUIDOMETER CORP.

Dept. R, LONG ISLAND CITY 1, NEW YORK

For more facts circle 324 on Reader Service card, p 99

Bookshelf

Begins on page 176

$9.00. McGraw-Hill Book Company, 330 W 42nd St, New York 36, N.Y.

This is the second edition of a widely used manual of technical and practical material on domestic and commercial oil burners. Emphasis is on installation and servicing.

Burner types and their parts are described. Steps in installing burners are covered, from determining the gph rate for both new and converted installations to putting in the various types of control systems. Chapters are devoted to methods of servicing burners: solving problems of low combustion efficiency, smoke and soot, vibration and pulsations, excessive fuel-oil consumption and under- or over-heating. Original charts analyze and break down the primary causes of service trouble.

New Water For a Thirsty World. *By M H Salzman. 210 pp, cloth, $5.95. Science Foundation Press, 73314 Ascot Station, Los Angeles 3, Calif.*

Taking a fresh look at the water problems of the world, book crosses several scientific fields to argue the presence of fresh potable water flowing in solid rock fissures. The theory has not found general acceptance, but there seem to be many fields of water that can be explained by the formation of "juvenile" or "new" water deep in the rock crust of the earth. This would lead us to expect that the basic amount of usable water of the earth is steadily increasing, instead of being a constant quantity world-wide. A stimulating and provocative discussion of the problem, its relation to "scientific" attitude.

Electromagnetic Energy Transmission and Radiation. *By R B Adler, Lan Jen Chu, R M Fano. 648 pp, $14.50. John Wiley & Sons, Inc, 440 Park Ave S, New York 16, N.Y.*

Intended primarily as a text for today's electrical-engineering seniors, this book extends electromagnetic theory beyond what was ordinarily covered in undergraduate schools only a few years ago. It should be useful, therefore, to practicing electrical engineers who would like to learn more

BEHIND THE MACHINE . . . in small steam turbines

PROGRESS in the development of turbine-generators has been continuous at AEI for over fifty years. A progressive research policy solves the problems of manufacturing more reliable, more efficient and more versatile turbines and generators. Speedy delivery and competitive prices are other factors that contribute to AEI'S leadership in this field of manufacture.

Advanced research techniques and modern experimental equipment have led to the development by AEI Turbine-Generator Division of blade forms that have helped to reduce flow losses in steam passages to a new minimum.

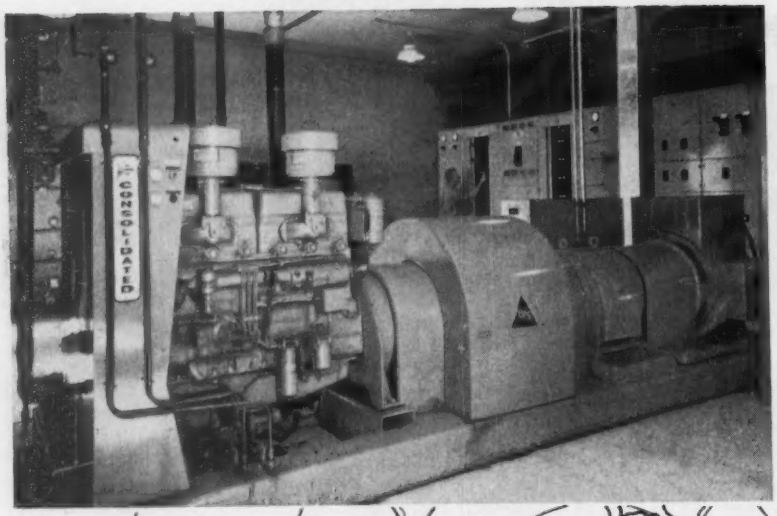
AEI Turbine-Generator Division makes **geared turbine-generators** from **300** kW and **direct-coupled** machines from **500** kW. Designs include **back-pressure** and **extraction** machines. Geared sets can be **self-contained** with the condenser integral with the exhaust casing.

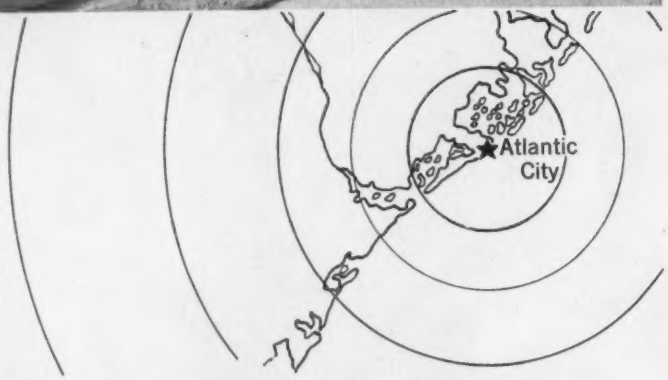
Produced by AEI Turbine-Generator Division, Britain's largest manufacturer of turbine-generators.

AEI **Associated Electrical Industries Export Ltd**

33 GROSVENOR PLACE, LONDON SW1

B/L004/1





Condec UPS Selected by FAA for Use in New Experimental Air Traffic System

A new concept of air traffic control is now being tested by the Federal Aviation Agency in an experimental electronic system installed in Atlantic City. With flight plans for planes aloft over the United States or enroute to the United States stored in its mammoth memory, the computer system constantly analyzes and updates position reports to warn of collision possibilities.

At jet speeds the pattern changes with such rapidity that even a few seconds' loss of power is intolerable. Because the Condec Uninterrupted Power Supply eliminates power outages when commercial power fails, it has been chosen by the FAA to participate in the test.

If power loss for a few seconds or even microseconds can spell calamity in your operation, a Condec Uninterrupted Power Supply may be your cheapest form of insurance. It prevents power outages entirely.

For full information, write or call Mr. Frank Cesario, DAvis 5-2261, DDD Code 203.

Uninterrupted Power Supplies

Condec Uninterrupted Power Supply is a complete, packaged system for assuring absolute continuity of electrical power.

- two types — single dynamo and motor-generator
- 5 to 200 kw capacity
- full power without interruption to load
- maintains voltage within 2%; eliminates voltage regulators at load
- frequency maintained within 3.5% during transition

POWER EQUIPMENT DIVISION

CONSOLIDATED DIESEL ELECTRIC CORPORATION

STAMFORD, CONN.

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Bookshelf

Begins on page 176

about electromagnetic theory. Authors have tried "to gather up the important linear-systems concepts of the time and frequency domains, and the energy-power relations from the theories of lumped circuits and quasi-static fields, and extend them to cover 'distributed' situations in which *space* assumes an importance equal to that of the other independent variables."

This book follows *Electromagnetic Fields, Energy, and Forces*, by the same authors.

Handbook of Noise Measurement. *By A P G Peterson and E E Gross Jr. 132 pp, 7 x 10, illust, soft cover, $1.00. General Radio Co, West Concord, Mass.*

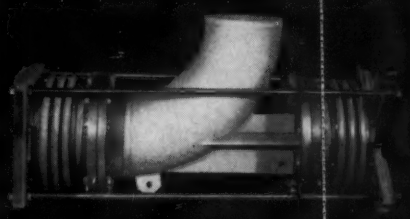
This handbook is well illustrated with line drawings, curves, charts and photos. It covers measurement of noise and vibration, describes equipment requirements, procedures and the interpretation of results.

In its 13 chapters, the book takes a comprehensive look at such topics as the decibel, man as a noise-measuring instrument, applications and sound-measurement systems. Measurement of sound and sound-pressure levels is discussed, plus typical noise sources, vibration measurement. Reports cover typical instrumentation and applications.

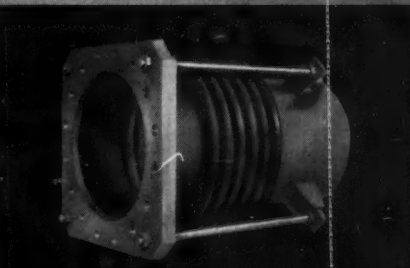
Four appendixes include decibel-conversion tables, vibration charts, definitions and extensive references.

"I wondered what had become of that piano player."

This pair of universal expansion joints is installed in the vapor piping of a gaseous diffusion plant. The lines carry Freon 114 at pressures up to 500 psig and temperatures ranging from −20°F to 300°F. Joints accommodate 3" lateral movement under these extremely harsh service conditions.



A 12" pressure balanced elbow assembly specially engineered by Badger for use in LOX storage and transfer facilities at an Air Force Missile Base. The unit is designed to operate at temperatures from −297°F to 250°F — a thermal shock range of nearly 550°! Operating pressures vary from 0 to 150 psig. Joint movement: 0.8" axial, 0.15" lateral.



One of eight specially engineered Badger Expansion Joints at a power plant for algas recovery unit in Texas. Installation is on a cooling water piping of the surface condensers where service conditions require operation at 55 psig at a temperature of 107°F. The joints are designed to absorb ½" lateral movement in combination with ¼" axial movement.

This 24" x 44½" I.D. rectangular expansion joint, connects the turbine and condenser at a steam power plant. Each of the units is designed to operate at a pressure ranging from full vacuum to 1 psig at a temperature of 360°F. The joint handles ½" axial compression and a plus or minus ½" lateral movement.

TOUGH JOINTS

— BADGER SPECIALTY

Anyone with the necessary manufacturing facilities can fabricate expansion joints. But it takes an *experienced* manufacturer to analyze tough piping problems properly and then provide the correct expansion joints to solve them. Badger, with more than 55 years in the field, has had more experience with a wider variety of special design problems than any other expansion joint manufacturer. Put this store of skill and knowledge to work for you — get the most effective and economical solution to your expansion joint problem. Call or write for complete information about Badger S-R Expansion Joints and our "on-the-spot" engineering service.

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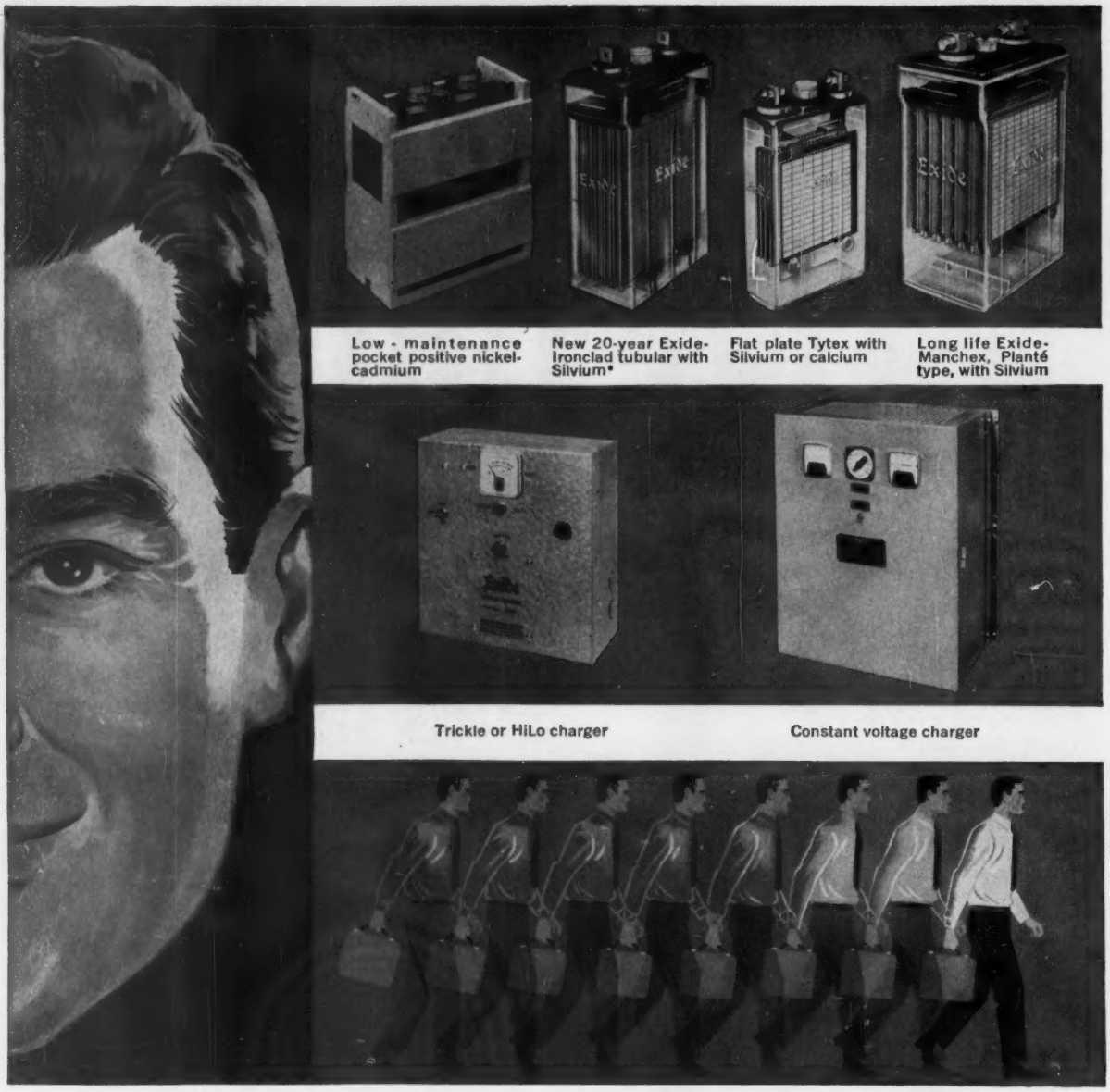
Representatives in Principal Cities



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Battery application requirements are usually somewhat different for every installation. No one battery type is most economical everywhere. The fact is that the selection should be made on a basis of engineering calculation. This is what your Exide man does. And he can do so freely, because he sells not only the broadest line, but the complete power package: batteries, chargers and factory-supervised service.

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*Silvium is Exide's patented corrosion-resistant grid alloy

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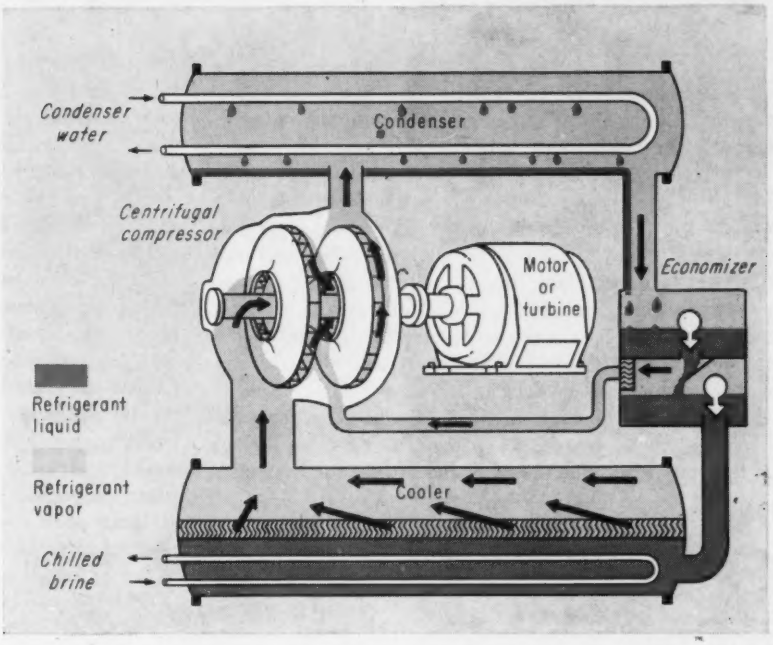
ESB

For more facts circle 328 on Reader Service card, p 99

STEVE ELONKA
Associate Editor in Charge



Care you take now may avoid costly shutdowns next cooling season. Take a look at these...

19 steps in overhauling centrifugal-refrigeration equipment

By WILLIAM J WREN
Carrier Air Conditioning Co

Complex centrifugal refrigeration equipment is one of your *big* capital investments. A logical *PM*—preventive maintenance—program for centrifugal equipment divides into three basic inspection periods: at startup, during operation and at shutdown. Of the three, the shutdown overhaul is perhaps the key to efficiency and longest possible trouble-free life. A thorough check after a full season of operation may reveal warning signs of trouble. Right now is the best time to make the overhaul.

Centrifugal system, above, chills water, brine or other liquids for air conditioning and process refrigeration. There are two types of machines, open and hermetic; each involves the same seven major elements.

(1) The cooler is a heat exchanger where water, brine or other liquid, passing through tubes, is cooled by evaporation of refrigerant on outside of tubes. (2) Compressor compresses refrigerant vapor or gas pulled from the cooler and discharges it into the (3) condenser, an exchanger where heat absorbed in the cooler is transferred to water, brine or other liquid. In the process of giving up absorbed heat, refrigerant changes into the liquid state. (4) Economizer contains two float-valve chambers where a small portion of liquid refrigerant evaporates, precooling the condensed refrigerant before it passes on to the cooler. This saves power and tube surface in the cooler. Refrigerant vapor or gas goes direct to the second stage of the compressor, so it's compressed through only half the pressure range of the main volume, for a further power saving. (5) The purge is a small condensing unit with

EDITOR'S NOTE: *This is the second of a 5-part series on shutdown maintenance of air-conditioning and refrigeration systems, all authored by W J Wren. Part 1, in Sept* POWER, *pp 203-205, outlined steps in overhauling an absorption system. Upcoming parts will cover reciprocating systems (in Dec* POWER*), cooling towers and air-handling systems.*

separator. It continuously extracts gas from the top of the condenser and purifies it by removing noncondensable air and water vapor which may be present. (6) The drive is the prime mover which supplies power to run the compressor. In the open machine, this drive usually involves an electric motor with speed-increasing gears or a steam turbine. A hermetic machine uses only the electric motor, and this is enclosed with the compressor in a single casing. (7) Controls govern the leaving temperature of water, brine or other liquid, protect various operating elements and start and stop the machine as needed to hold desired temperature.

Let's run down a good order of procedure for overhauling typical centrifugal machines. First we'll look at the open type, then see what *PM* is best for hermetics.

Open centrifugal

Work on the compressor first. The thrust bearing in this unit is probably the most important single part of your entire machine. Proper care here can prolong machine life; lack of care can abbreviate it.

An easy way to check the thrust bearing for wear is to measure the seal gap, Fig. 1, when the machine is new and on each shutdown. When new, the gap will measure between 0.030 and 0.060 in. As this measurement increases, it indicates that the bearing is undergoing wear. This may be perfectly normal, but when you notice the reading has increased 0.002 to 0.003 in. in a year, it's time to remove the thrust assembly and inspect parts for unusual wear. When the initial reading increases by 0.010 in., Fig. 2, it's a signal that the bearing will probably not last another season and should be replaced. This could happen at any time from a few years to never, depending on usage.

Next, drain oil from the seal-oil reservoir, atmospheric float chamber and main oil sump. After you've finished servicing the centrifugal, fill it with new oil. Acids in used oil could start a corrosion process if left in the machine for long periods of time.

If oil level in the seal-oil reservoir drops during shutdown, it may signal seal leakage. Inspect the seal and replace it if necessary.

Remove liners of the seal and thrust-end bearings and look for wear, Fig. 3. Replace the seal-oil-reservoir filter, Fig. 4. Check operation of suction damper. Inspect the shaft worm and brass-oil-pump gear. Be sure the oil heater is operating during shutdown. If sight glasses are dirty, remove and clean them.

Condenser tubes should be inspected for scale or other foreign material. Drain the water and remove tube heads. If scale formation warrants it, the tubes should be cleaned. A variety of brushes are available for removing soft scale or mud, but hard-scale removal involves chemicals. If scaling is excessive, consult a qualified water-conditioning company.

Cooler tubes should also be inspected and cleaned if necessary. The refrigerant should be removed and stored in drums if ambient temperature is high enough so you think it might produce pressure within the centrifugal machine during shutdown.

Leak test, Fig. 5, is one of the most important checks you can make during the winter shutdown inspection. It must be thorough, and if you find any leaks, fix them right away. Leaks are most likely to occur around the cooler rupture disk or relief valve, cooler-condenser expansion joint, suction damper seal, low-refrigerant-cutout bulb in cooler blister, as well as valves, flare connections and gage connections in the purge unit.

Leak-test the cooler and condenser tubes and the compressor oil cooler, as well. You can check them quickly by removing drain connections on the bottom of the cooler and condenser waterboxes and unhooking one water connection at the oil cooler. Any sign of leakage at these points would call for removing heads or oil cooler for a closer look. First, be sure to valve off the cooler or condenser and drain it.

The purge is one of the most important parts of the machine—yet it's often misused. It is not simply a pump to keep the machine free of air and moisture. A second, vital function is warning you when air or water is leaking, so the purge should be operated continuously when the machine is running. During operation, check the sight glass for water and record amounts drained, Fig. 6. This is information the service engineer can use—an indication to him of performance and tightness of the entire machine.

Shutdown inspection of the purge must be thorough to do any good. Your checklist should include tightness of all connections, Fig. 7, as well as a leak test and a general look at operation. The weir standpipe, baffle plate and float valve in the separation chamber should be checked and replaced if necessary.

Be sure the purge compressor is working properly and inspect its belt for tension and wear. Clean the motor. Check setting of the purge air-relief valve. If the compressor's oil level is above the sight glass when the purge is running, drain some oil to bring it in sight.

In electric drives, inspect starter contacts for burning. Replace or reface them if necessary. Check starter operation and look for loose connections. On variable-speed motors, inspect the drum controller for smooth operation and resistance elements for loose connections.

Turbines should be checked for inlet and outlet steam pressure, or vacuum if your equipment employs condensing turbines. Check oil pressure and watch for excessive vibration while the turbine is running.

Motors should be cleaned of as much foreign material as possible. If they're oil-lubricated, drain and refill. Check end play for a clue to thrust-bearing wear.

Safety controls should be inspected for correct operation, calibration and settings, Fig. 8. This includes the condenser's high-pressure cutout, low-refrigerant-temperature cutout, purge's high-pressure cutout, low-chilled-water-temperature cutout and low-oil-pressure switch. All turbine safety controls should be examined. Operating controls such as the chilled-water controller and automatic speed control also need a close look.

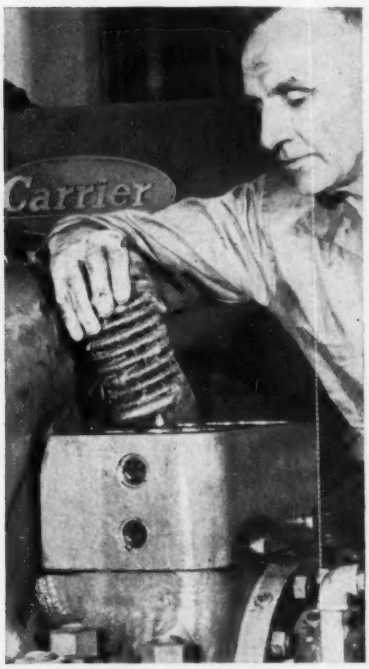
continued

How to overhaul open centrifugals

1 Measure the seal gap of your thrust bearing with a feeler gage to detect wear

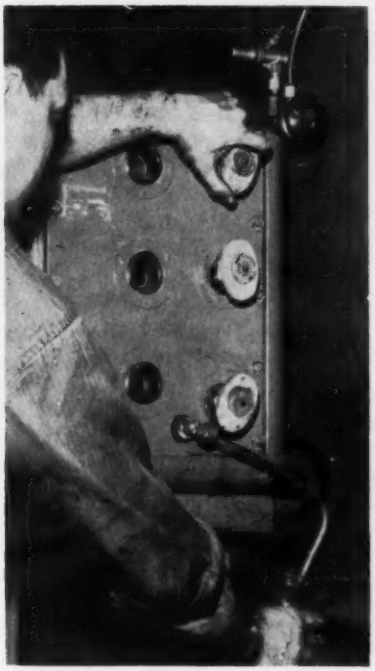
2 Replace bearing if wear has increased as much as 0.010 in. from original

3 Remove the thrust-end-bearing liners and inspect them carefully for wear

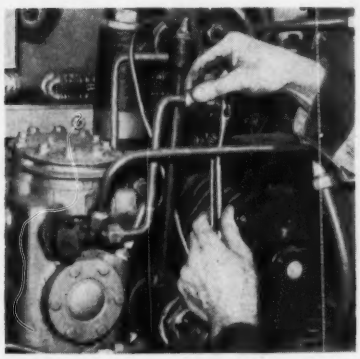


4 Inspect the seal-oil-reservoir filter; be sure to replace it if necessary

5 Use the leak detector around cooler rupture disk or relief valve, joints

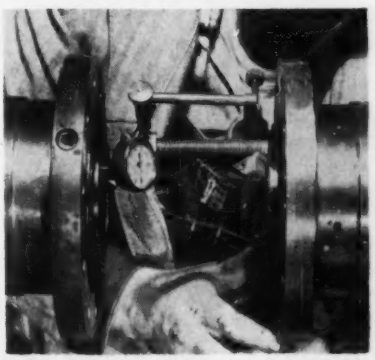


6 Check the purge sight glass for water—this indicates a leak in the machine



7 Check purge connections for tightness, then make careful leak-detection tests

8 Operation, calibration and settings of safety controls need careful checking



9 Coupling alignment should be checked with dial indicator to protect bearings

turn page

Speed-increasing gear should be drained of oil and refilled with fresh oil. Inspect the gear teeth for wear. Open the couplings and examine their teeth. Replace the couplings if necessary. After you've removed old oil or grease from them, relubricate according to the manufacturer's instructions. Check alignment of couplings, Fig. 9. They should come within 0.002 in. of parallel and angular alignment for best service.

Hermetic centrifugal systems

Compressor-motor assembly on a hermetically sealed machine should be carefully looked over for wear and leakage. Check the thrust bearing and shaft journal bearings for wear and proper clearance, Fig. 10. Examine the motor-winding insulation for defects.

See that the economizer damper is working right and with proper clearance, Fig. 11. Drain oil, clean or replace the filter, Fig. 12, and recharge with new oil. Check oil heater, its thermostat, oil-pressure-regulating valve and water-regulating valve for proper calibration. Test operation and calibration of thermometers, Fig. 13.

Cooler and condenser need about the same maintenance that those on an open centrifugal do. Inspect the condenser and cooler tubes for sediment or scale and clean them if necessary. Check the cooler and condenser pressure gages; recalibrate them where required.

Safety controls need their operation and calibration tested, and so do the electric contacts. Check operation of all relays and cutouts. On your operating controls, remove and inspect dashpots, Fig. 14, and clean contact points, Fig. 15. Vacuum tubes in chilled-water and motor-overload control modules should be replaced each year, Fig. 16. Leak-test the entire machine. As with the open centrifugal, this is a vital part of inspection. Break the vacuum and raise machine pressure to about eight psig, then go over all flanges and pipe connections.

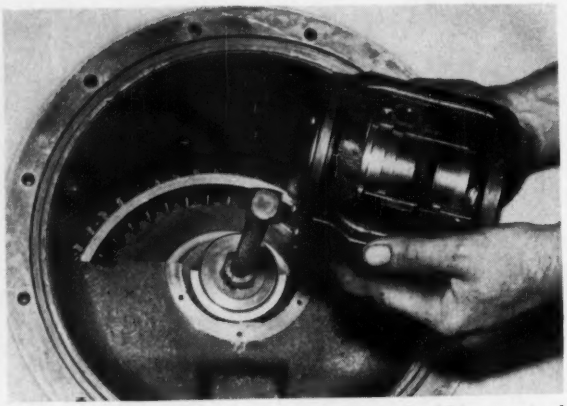
The purge unit should be carefully inspected and cleaned. Clean the purge separation chamber and inspect operation of the float valve, Fig. 17. Clean the oil separator and screen, Fig. 18, and check this float valve, too. Inspect and lubricate the purge motor and adjust belt tension if it needs it. Change oil.

Check the compressor for proper operation. If necessary, replace the valve-plate assembly, Fig. 19.

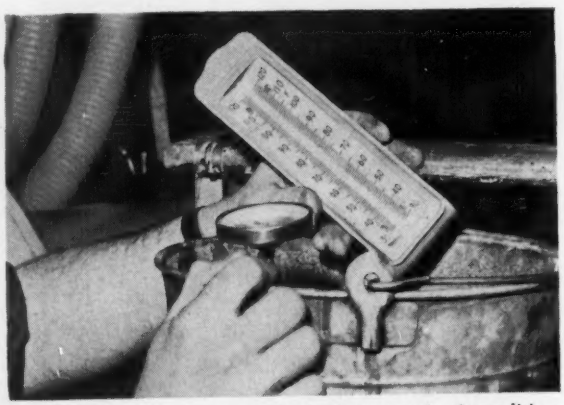
Correction

POWER's *Air-conditioning survey*, Oct 1961, erroneously listed Jaros Baum & Bolles as consultants for the Bank for Savings Building (Project 17, pp 103-105) in Birmingham, Ala. Rather, James A Evans of Birmingham was consulting engineer for this project.

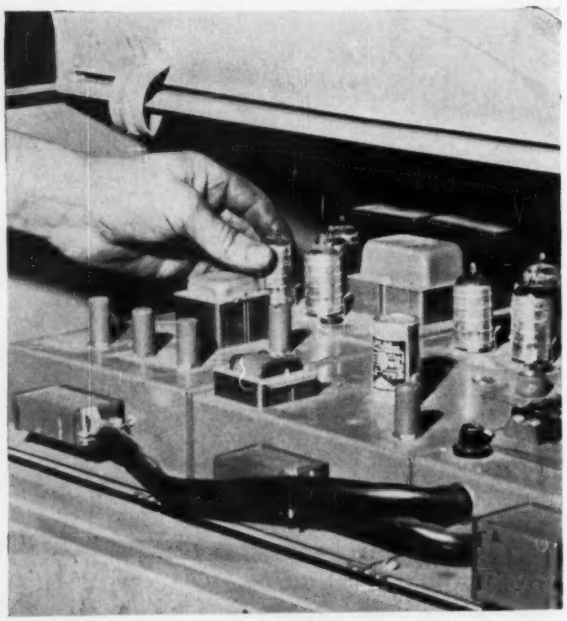
Hermetics and their



10 Thrust bearing and shaft-journal bearings should be examined for wear and proper clearance. Examine motor insulation, too

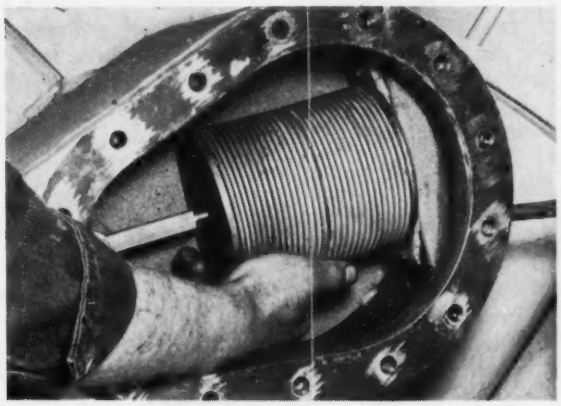


13 Watch your thermometers. They're important in air-conditioning systems but may give false readings without detection

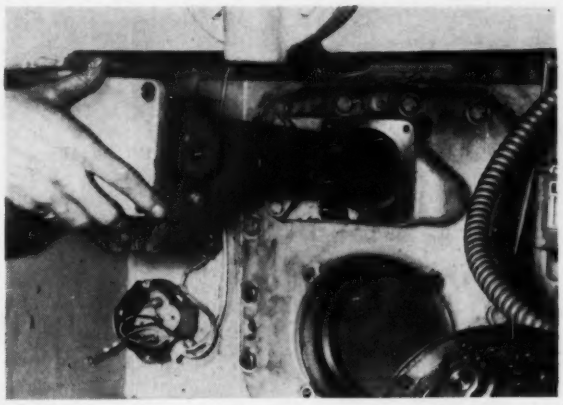


16 Replace vacuum tubes in chilled-water and motor-overload control modules every year. Neglect means trouble for you

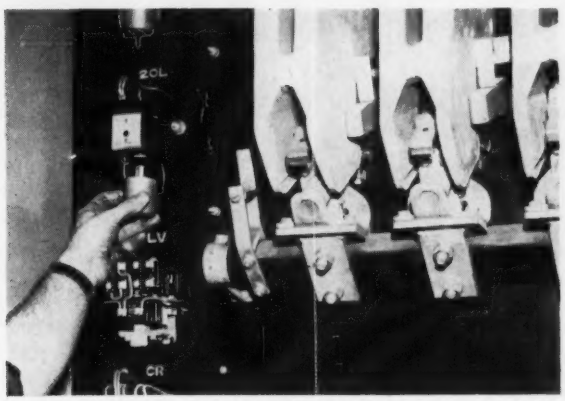
electric controls need this careful attention at shutdown



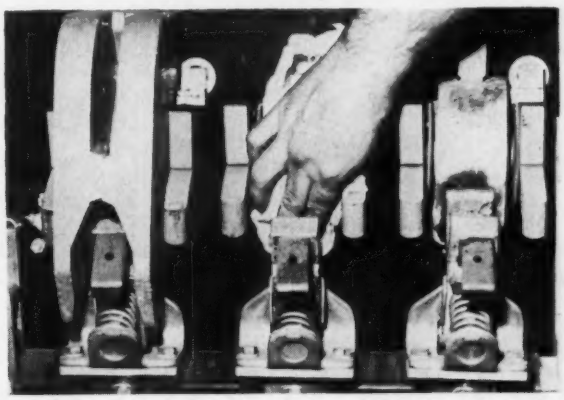
11 Remove cover from space containing the economizer damper and check operation, clearance (as manufacturer advises)



12 After you've drained oil from the machine, clean or replace filter, then add new oil and check the heater and thermostat

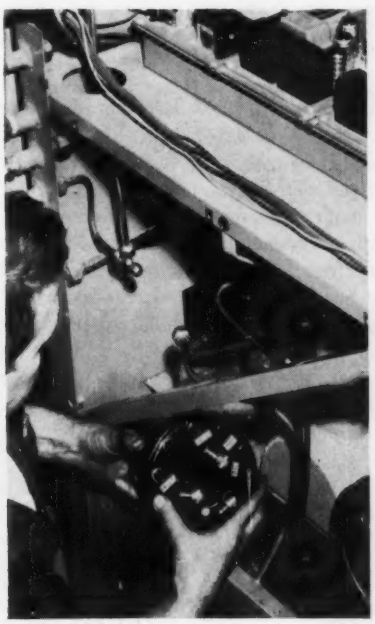


14 Check operation and calibration of all safety controls. Don't forget to remove and inspect operating controls' dashpots

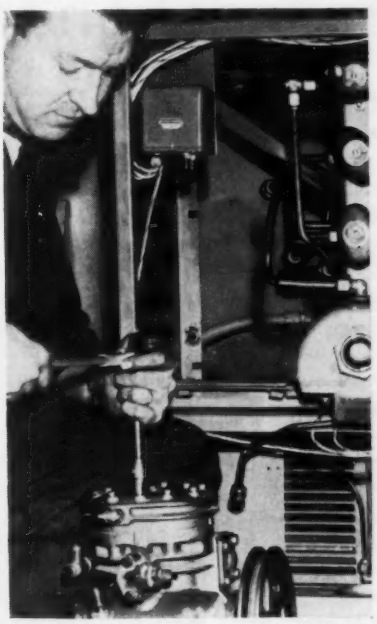


15 Carefully clean the contact points of electric controls. This will prevent faulty operation during next busy cooling season

17 Inspect and clean purge-separation chamber; check float-valve operation



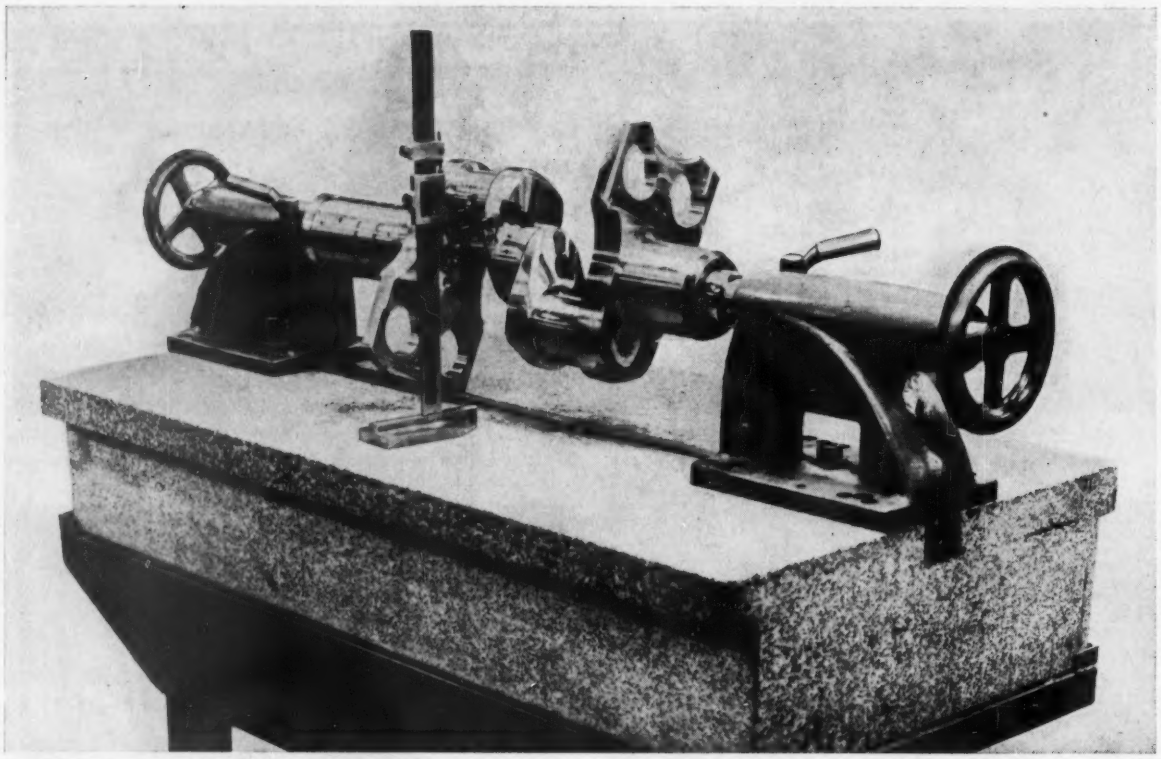
18 Clean the oil separator and screen; look at operation of its float valve



19 Compressor needs a careful going-over. Replace valve-plate assembly if worn

OPERATORS NOTEBOOK **152**

By STEVE ELONKA, Associate Editor



GRANITE PLATES are often machined to mount special checking equipment. Surface plate above has tee slots into which tail stocks fit.

Granite surface plates: foundation for precision measurements

Granite, one of the most durable materials found in nature, may be finished into a plate of close to perfect flatness. With machinery tolerances becoming ever more critical, plant maintenance shops as well as energy-systems-equipment manufacturers find they can't get along without reliable reference points on which to base their measurements. Metal surface plates traditionally filled the bill, but since World War II, granite has bid for its share of the job. Turned into precision products, slabs of the stone take a surface finish accurate to within 10-millionths of an inch of absolute flatness.

Proponents cite these reasons for using granite instead of metal surface plates: Granite won't rust and doesn't need special moisture protection. It's nonmagnetic, won't attract troublesome metal particles. Granite plates may wear longer than metal. They do not swedge, which means that material will not bulge up around the dent caused by a blow by a pointed object. Even though a sharp enough blow may chip out a piece of granite, it still won't affect the plate's overall accuracy.

When granite has been finished, it is the smoothest and least abrasive, as well as hardest, of all suitable igneous rock. Before the Herman Stone Co of Dayton, Ohio introduced granite surface plates during World War II, they tested a variety of granites. They wanted to determine wear characteristics so they could use the best type.

They found that granites wearing the longest contained a high percentage of quartz. Quartz, it seems, is more than twice as resistant to wear as the feldspars and other principle components of different granites.

Where an extremely hard, smooth and noncorrosive bearing material is needed, quartz is often selected. Quartz crystals, highly polished as they are in a surface plate, act like jeweled bearings on which the tools and instruments ride as they move across the plate.

Best surface plates are made of a pink granite with the extremely high quartz content of 25 to 30%. Plates come in all sizes and shapes, from a few lb on up. Incidentally, world's largest 1-piece granite plate is owned by the Ford Motor Co. It measures 20x10x20 ft.

You can get plates designed for mounting special equipment to aid measurement and checking operations.

Plates are made with threaded inserts, adapter holes, tee slots (photo at left) and dovetail slots for holding work or attaching indexing heads, bench centers and similar equipment. Plates are also made with their edges or sides, as well as the top surface, precision-finished. This provides a second accurate reference plane, allowing both vertical and lateral gaging of work at the same time. Any edge can be finished straight within 0.00001 in. in three ft, squared to the top surface within 0.001 in., squared with adjacent edges within 0.0001 in. per ft, or parallel with tee slots, dovetail slots or opposite edges within 0.001 in. in five ft.

Many of today's precision tools are made of granite. Inside square plates, toolmakers' flats, angle blocks, riser blocks, parallels and straight edges are all available made out of the durable stone.

Be sure your plate stays accurate

Your surface plate can't do its job if it's not flat. Since you use it for all-important measurements, it pays to keep a close watch on its accuracy. Check it at regular intervals, and never make a critical measurement without a quick check of flatness. If plate proves to be out of tolerance, have it relapped at once.

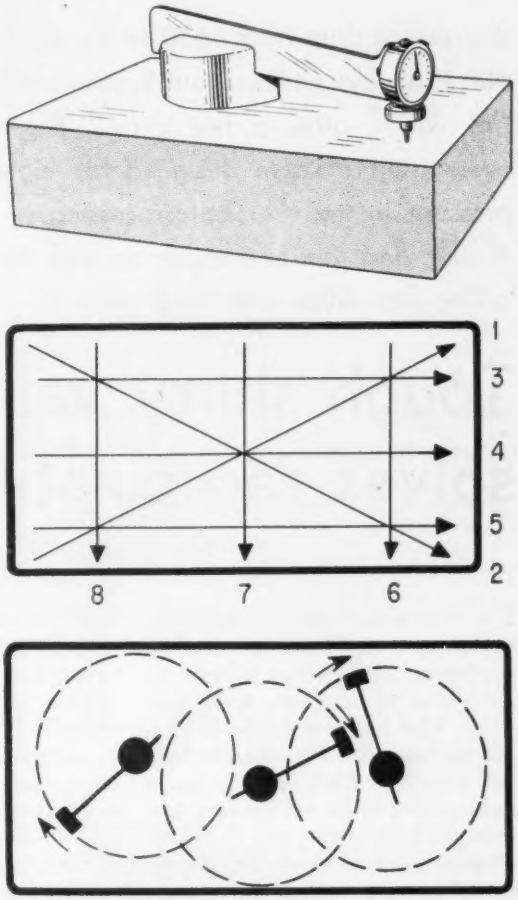
Inspection instrument, top sketch, measures the accuracy of any type of surface plate. Its dial indicates overall tolerance deviation. This instrument comes with a specially finished master surface plate of granite, accurate to 10-millionths of an inch.

The 8-pattern method is a good one to follow when testing a plate for flatness, second sketch. Move instrument diagonally across plate and note the needle's deflections. Follow this procedure along all eight lines. Another method is sweeping the instrument over the plate, third sketch. Use circular sweeps from several points.

Should the indicator suddenly give a minus reading while the checking tool is being moved across the plate, dial point has hit a worn or low spot. Maximum minus reading in that area is the amount of deviation. If the indicator suddenly gives a plus reading, the base of the checking tool is in the worn area. If the indicator holds a constant reading while it's moved across the plate, overall tolerance error can be calculated with this formula:

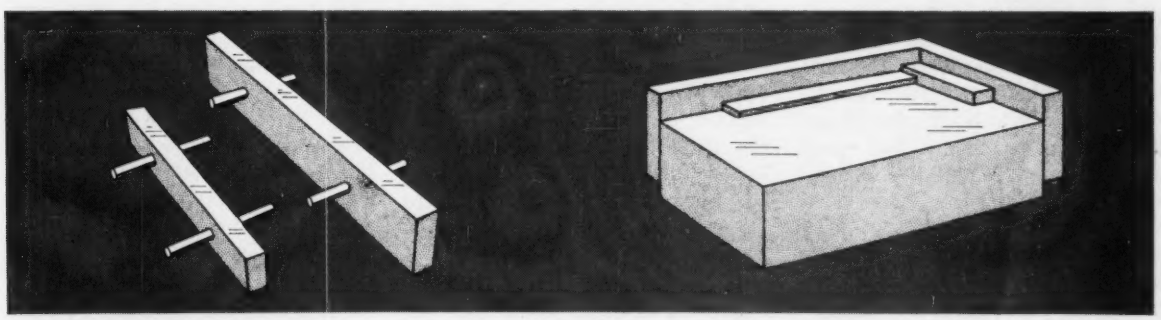
$$\textit{Overall tolerance} = \frac{\textit{length of checking pattern}}{\textit{span of instrument}} \times \textit{indicator reading}$$

A surface plate is a precision tool—not to be abused. Sad but true, in some shops a plate may be used for lapping-in valves with a coarse grinding compound, then cleaned off and used for delicate measurements. A surface plate should be used *only* for measurements, or *only* as a lapping tool. And it must be kept perfectly flat.



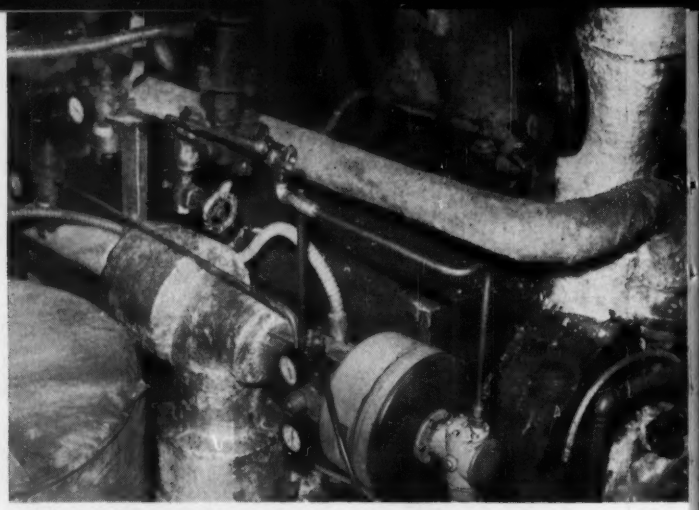
INSPECTION INSTRUMENT, top, mounts on master surface plate. You can test a working plate's flatness by the 8-pattern method, middle, or by using a sweep pattern, bottom

These designs handle some special measuring jobs



STRAIGHT EDGES made of granite are precision-ground and used for checking the accuracy of very large flat surfaces

INSIDE SQUARE PLATES are a new granite surface design. Used as shown, they speed the process of measuring three dimensions



OPERATING under a head differential around 1600 psi, this feed-pump bypass valve has now been on the job for over 200 cycles

A pressure drop from 1650 to 3 psig at 400 F always knocked out bypass control valves after a few cycles. Engineers tried a valve designed for high pressure in the chemical-processing industry, and this one shows no sign of giving up. After one long year . . .

Tough slurry valve solves recirculating problem

Every now and then we have the opportunity to borrow a piece of equipment from another industry to solve one of our own headaches. That's what happened at the Schuylkill Station of the Philadelphia Electric Company. Their problem was a bypass valve in the recirculating line from the boiler-feed pump to the deaerator: they could never keep it leak-free for more than a few cycles. Eventual solution was a control valve borrowed from the chemical-processing and petroleum-refining industries —a specially hard valve with 2-piece seat design.

One of the toughest jobs a control valve can take on at a power-generating station is bypass or recirculation service for the boiler-feed pumps. The leaking valve at Schuylkill was in the recirculating line for the feed pumps to boilers No. 23 and 24. These pumps run at high speed, and a lot of energy must be dissipated should pump discharges be completely shut off while the pump is working. So an automatic bypass is attached to the pump's discharge nozzle, right, to prevent pump from overheating.

To protect the pump at reduced flows (low boiler ratings), the automatic control valve goes wide open and recirculates boiler feedwater back to the deaerator when flow drops to 120,000 lb per hr. When flow demand climbs to 180,000 lb per hr, the valve closes again. Valve stays closed and is expected to hold tight shutoff except during the time the flow rate is low—hookup comes into service for starting, stopping, night loads and while pumps are being changed.

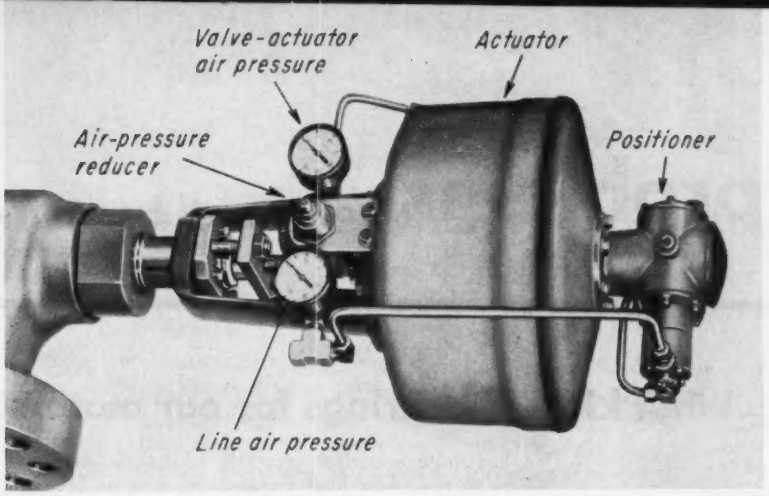
This service is a demanding one, and caused a chronic maintenance problem. Recirculating valves were the usual power-plant control valves with stellite trim. They had to operate at temperatures close to 400 F.

Trouble usually arose after a relatively few operating cycles. It was caused by the high pressure drops through the valves—from 1650 psig at the pump to about 3 psig at the deaerator. An extreme differential like this naturally sets up rapid erosion between plug and seat. Even the slightest leak past the trim while the valve is shut builds up to substantial leakage in a short period of time.

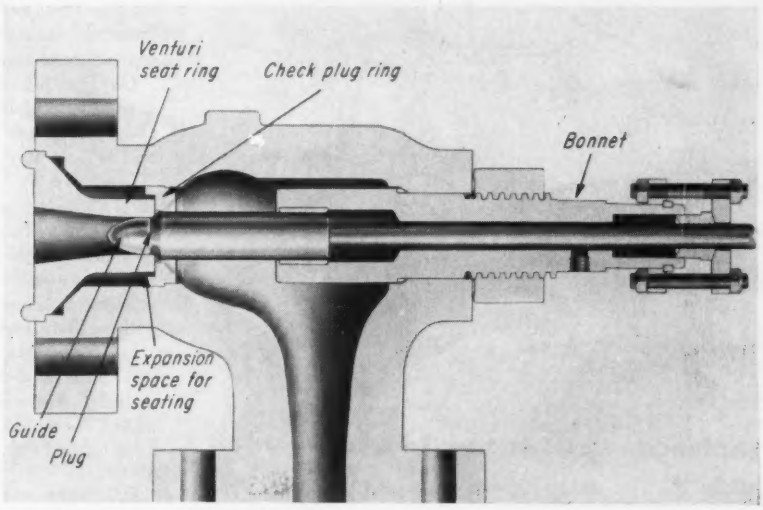
In winter, Schuylkill Station sells steam for heating, which calls for about 70% boiler makeup water. This means that the bypass control valve is seldom called on to cycle during the cold season. But in spring and summer, heating requirements fall off and the bypass valve must cycle almost every evening.

After several cycles the original valves would begin to leak. Leaks would rapidly progress to the point where the valves had to be cut off the line, remachined, then welded back into the line. Complete repairs averaged three a year per pump—an objectionably high repair number. Valve trim was replaced more often than that. And periodically costs shot far higher, when the valve finally had to be scrapped because it could no longer be repaired.

Solution was the control valve shown in photos. It had earned a good reputation handling slurries and operating under extremely high pressures in other industries—chemical processing, petroleum refining and the like. After preliminary engineering studies, this valve was installed at Schuylkill. It's a 1-in. 1500-psi control valve with pneumatic cylinder actuator. It has butt-welded connections, a 4 to 6% chrome-moly body and 17-14-PH (precipitation-hardened) stainless-steel trim.



POSITIONER and actuator supply muscles for recirculating the high-pressure feedwater when pump is on low load, since total demand wouldn't be enough to keep pump running

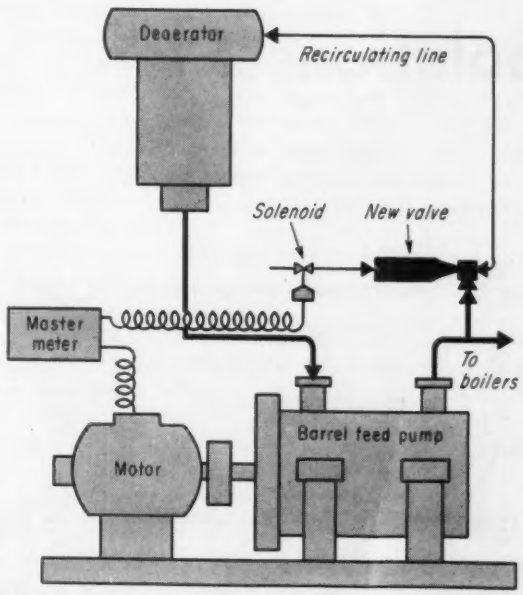


HARDNESS and the 2-piece seat get credit for valve's success. Seat-ring expansion features a sliding fit between plug and seat, giving tight shutoff at high pressure

The 2-piece seat design consists of a shroud (plug check ring) and a venturi-outlet seat ring. Seat expands slightly into the shroud when the plug is in the closed position, and a sliding fit between plug and seat insures tight shutoff at high pressures.

Combination of hardness and the 2-piece seat is credited with this valve's success in bypass service at Schuylkill. The conventional valves' trim showed wire drawing after only a few cycles, while when the new valve was disassembled and completely inspected after 24 cycles, no trace of damage could be found. After passing inspection with flying colors, it was immediately put back in service. It has now cycled over 200 times, and still shows no sign of wear and has required no maintenance.

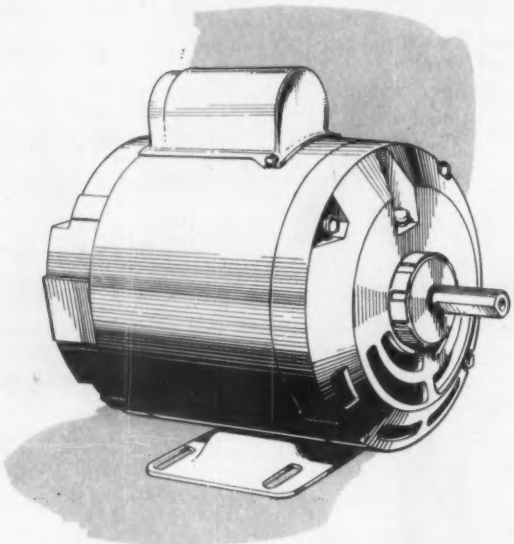
Another saving was realized: As trim started to fail on conventional valves, extreme erosion was experienced on downstream piping. So the piping, too, required frequent replacement. Since the slurry valve was installed, there's been no further downstream line erosion. On the basis of this first valve's success, Philadelphia Electric has installed them on all three boiler-feed lines.



AT LOW LOAD, this hookup bypasses feedwater from the barrel pump back to the deaerator. Then it's recirculated

These **plant problems** could well be yours...

What kind of bearings for our motors?



We had quite a problem recently with three small motors to run under high temperature, with no lube and no maintenance. We tried carbon bearings but were unable to make them perform satisfactorily. We finished up with special ball bearings designed for the temperature, but we still have high-temperature problems which means the ball bearings probably are not our ultimate answer.

Our motors are 1/100-hp 3200-rpm single-phase shaded-pole ¼-in.-shaft units, so bearing speed is only about 200 ft per min. These motors have to run at 180 F, 100% humidity ambient.

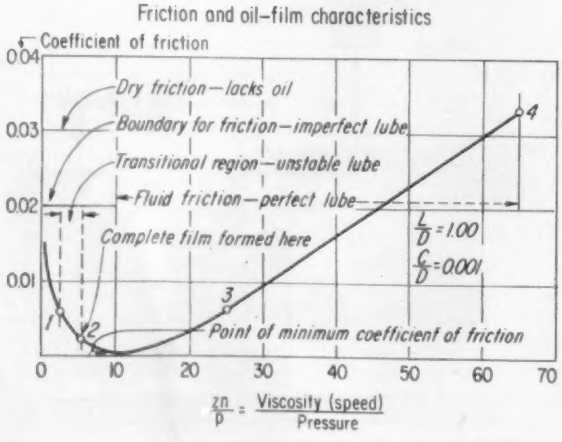
We know nylon and teflon cannot take the temperature. Carbon was fine with just a drop of oil on it, or if there was enough water on the surface. But running dry, the carbon bearings would either screech or try to seize up or not start at all.

What has been the general success, or lack of it, with carbon bearings? Has anyone with similar operating conditions found a way to make these bearings last? Has anyone found a different type of bearing material that can stand up to these operating conditions? We would like to hear from POWER readers who have figured out this problem.—*GR, July* POWER

Solutions...

Full-film lubrication will stretch bearing life

Friction and oil-film characteristics



In our experience, motor bearings are usually designed to permit full-film lubrication. Straight mineral oils of correct viscosity have adequate film strength to give service under *GR*'s conditions.

When a lubricant is injected between two metal surfaces which are pressed together and in motion relative to each other, the lube tends to keep the surfaces separated. Fluid friction then takes the place of the much greater dry or solid friction. The more effective the oil film, the greater the reduction of friction. Even the best lubrication is a compromise with various types and amounts of friction, since friction can never be totally eliminated.

Oil's viscosity at operating temperature determines the bearing friction, rise in temperature, rate of oil flow through the bearing and to a certain extent the bearing's load-carrying capacity. An oil of correct viscosity is also distributed quickly to rubbing surfaces, going a long way toward decreasing starting and stopping friction.

...Here's how Power readers would tackle them

BOB MARKS, Associate Editor

As a journal starts to rotate, it rolls uphill on bearing surfaces. Since the shaft is thus slightly off-center, the clearance is crescent-shaped, with a wedge-shaped end on each side of the load area. As speed increases, oil is drawn from the clearance space and from around the journal, forming a film for partial lubrication. Pressure built up in the film lifts the journal and tends to center it in the bearing. As speed is increased, more oil is drawn or pumped into the wedge between journal and bearing and a full fluid film is built up. Enough oil must be supplied to, and maintained in, the bearing to compensate for any loss caused by end leakage.

From points *1* to *2* on curve, facing page, the oil film is very thin and the bearing operates in the region of boundary lubrication. In this region friction depends on smoothness of bearing surfaces, adhesive strength of oil on metal surfaces and to a lesser extent on oil viscosity.

In the area from points *2* to *3* the film becomes somewhat thicker, so viscosity is more of a factor.

In the area from *3* to *4*, where curve is practically a straight line, fluid friction and thick-film lubrication are wholly dependent on oil viscosity. Bearings of other dimensions have similar curves.

Sleeve type motor bearings often require more cleaning than ball or roller bearings. Cleaning interval ranges from two weeks to several months. Ball bearings can function for twice this period, but are more delicate. Just a small amount of lubricant contamination causes rough running because of abrasion.

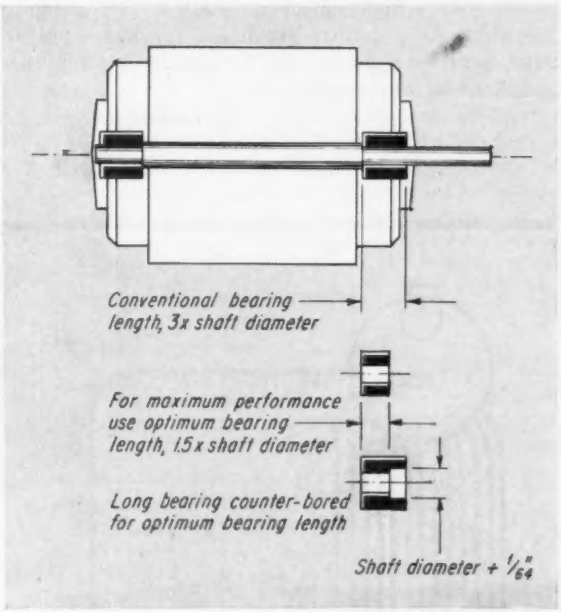
In general, all bearings specified for high-speed operation are super-precision types, made to meet requirements of Annular Bearing Engineer Committee No. 7. All commercially available bearings of this grade have nonmetallic-ball retainers. Research on metallic-ball retainers in alloys and other designs is under way.

Super-precision bearing with nonmetallic-ball retainer permits a grease charge of only 2.5 to 3.0 grams. By comparison, a bearing with metallic retainer takes from 5.0 to 6.0 grams. In addition to its bulk, the nonmetallic retainer does not readily lend itself to grease lubrication. Its smooth surface provides no irregularities on which grease can cling. As a result, grease is thrown off the edge of the bearing's outer race and is not readily available for lubrication.

Our experience with small high-speed motor bearings has sold us on grade AN-G-15a, an all-purpose aircraft lube. Modern greases can be made to supply satisfactory lubrication at high rotative speeds, opening up an ever-broadening field for this type of lubrication.

Graphite bearings, in our estimation, are a vast improvement over dry carbon, no matter how accurately machined and fitted. But they should be designed for additional wearing surface when space permits.

E C Cross, *Oak Ridge, Tenn.*


Conventional bearing length, 3x shaft diameter
For maximum performance use optimum bearing length, 1.5x shaft diameter
Long bearing counter-bored for optimum bearing length
Shaft diameter + 1/64"

Ratio of length to diameter is important

GR's small motors are not the only ones with bearing trouble. However, contrary to his experience, we found that carbon-graphite bearings have good bearing qualities under adverse conditions, eg, at high temperatures they operate bone-dry with no maintenance.

Our experience also indicates that long-length bearings and very slight misalignments with inadequate running clearance spell trouble. Scuffing and screeching or even seizure result no matter how smooth the opposing bearing surfaces. To increase reliability, improve performance and reduce problems caused by minimum misalignments, proper bearing length-to-diameter ratio, shown above, is extremely important.

Expansion coefficient of carbon-graphite is practically zero. So shaft expansion at operating temperature governs initial bearing clearance.

The method of prevention for *GR* is obvious: (1) maintain proper running clearance (2) make sure there is a very fine polish for opposing bearing and journal surfaces and (3) use short-length bearings.

E Wittmann, *Villas, N.J.*

Try bronze bearing inlaid with graphite

An improved version of the carbon sleeve type previously used by *GR* is a bronze bearing inlaid with pressed graphite in diagonal grooves around the sleeve. Another recommendation for small sizes is a porous bearing made

of compressed and sintered powdered metal. This bearing, which proves to be very strong, is impregnated with graphite, high-temperature silicone grease or molybdenum disulfide (similar to graphite but twice as dense).

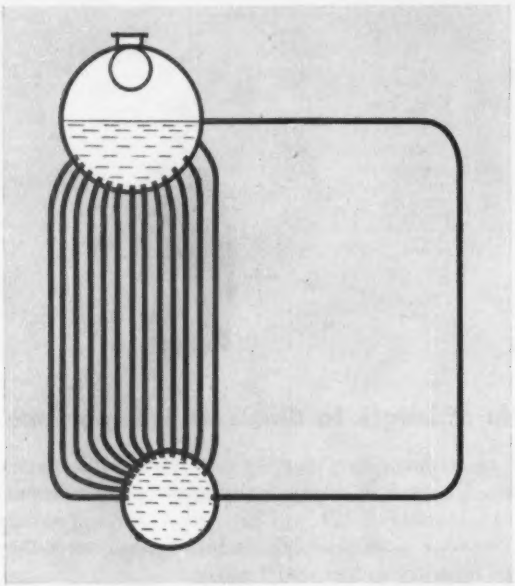
If motors are operated on a frequent stop-start schedule, *GR* might again try ball bearings. But make sure they are sealed with a high-temperature (210 F) silicone-grease lubricant. As a further precaution for higher-temperature operation (around 257 F) specify bearings heat-stabilized during manufacture.

J T NORRIS, *Babylon, N.Y.*

Special bearings are also available

Silicone-base greases can be used up to 300 F, and you can get special ones for 500 F. Metal bearings with a PTFE (polytetrafluorethylene) resin lining are satisfactory in h-t confines without lubrication. Addition of a fiber-cloth backing allows 550-F operation, also without lube. Details are given in two papers, *61 AM 6B-2* and *-3*, presented at a recent meeting of the American Society of Lubricating Engineers.

H B WAYNE, *Woodhaven, N.Y.*



Problem . . .

How do we acid-clean our boiler?

We have had no experience descaling a boiler with acid treatment. However, we are planning on doing just that to our 380-hp 3-drum watertube boiler. We intend to use sulfamic acid at the rate of approximately ¼ lb per gal and to boil the acid-water mixture in the boiler for 24 hr.

Analysis of the scale indicates it's primarily calcium and magnesium carbonate and, as such, readily dissolves in acid. We would like information on techniques and procedures of acid-cleaning a boiler with sulfamic acid. Any help POWER readers can give us would be greatly appreciated.—*DLH, July* POWER

Solutions . . . Carefully follow detailed operating instructions

DLH should first estimate water-holding capacity of the system or equipment to be cleaned. Start with a cleaning-solution strength of one lb of sulfamic for each gal of water in the system. Every lb of cleaner will dissolve ½ lb of scale. The cleaner may be added dry, either through open vents, sumps or manholes, or you may dissolve it in a 55-gal drum or other holding reservoir. Concentrated solutions can be added to equipment and then water poured in to dilute them. As much as one drum (100 lb) of sulfamic can be dissolved in 55 gal of hot water—at 160 F. High concentrations of sulfamic are not damaging and, in fact, will speed up the cleaning reaction.

For most rapid and effective cleaning, solutions should be circulated or agitated. A centrifugal pump, eductor, air or steam jet, submersible pump, etc can be used to agitate and circulate. In many systems, the normal circulating pumps will keep the fresh, strong acid in contact with the scale at all times. A drum can be installed in the circuit both as a surge tank and as a convenient point where more cleaner can be added. A static or soak procedure may also be used where circulation is impractical. Carbon-dioxide gas formed as a result of cleaning should be periodically vented from closed vessels to prevent excess pressures from building up in the system.

Time required to clean a system will vary. It depends upon the amount of scale present, the circulation rate, solution strength and temperature. Any time from 1 to 24 hr may be necessary. If you heat cleaning solution to a temperature of 140 to 160 F, reaction will be faster and less time will be required to complete the job. Cleaning solutions can be heated by direct steam additions, with a steam-jet eductor, immersed heating coil or by light firing

of equipment. Scale will dissolve about 2½ times faster at 160 F—the maximum recommended temperature for sulfamic acid—than it will at room temperature. With good circulation of warm cleaning solution, 4 to 6 hr should be adequate to complete most cleaning jobs.

Periodic checks should be made during the cleaning operation to be certain the solution remains acid—pH less than 3.5. If the pH goes above 3.5 as the scale dissolves, cleaning strength may be bolstered as often as needed by adding more sulfamic acid. It is not necessary to drain the equipment each time this is done.

If deposits are oily, better cleaning is possible if equipment is first flushed with an alkaline solution or a low-sudsing detergent, then rinsed thoroughly with water. When acid cleaner is added, it will quickly penetrate and dissolve scale deposits. If the deposit also contains iron oxide, adding ½ lb of ordinary salt for each lb of cleaner will improve cleaning. Salt may be dissolved with cleaner when preparing cleaning solutions.

When acid strength of the cleaning solution remains at a low pH and there is no more bubbling due to formation of carbon dioxide, the cleaning is complete. Drain spent acid and debris and flush the equipment with water. Since it may not be possible to completely drain or adequately flush all areas, neutralizing rinse with a solution of caustic soda or soda ash is suggested. If there is chance of stream pollution, spent acid solution can be mixed with neutralizer before it is discharged into sewers. After cleaning, a good inhibitor should be added to the water used in equipment to prevent corrosion and buildup of further scale deposits in the boiler.

S M Ziarkowski, *Pittsburgh, Pa.*

Acid cleaning is job for specialist

To *DLH* I would only say that undertaking acid cleaning of a boiler without complete and very specific know-how makes about as much sense as trying to remove one's own tonsils. This is no job for even the most ardent do-it-yourselfer; it is a job for highly skilled professionals backed by extensive lab facilities and equipment.

During the war I saw some marine boilers that had been completely destroyed by well-meaning amateurs trying to acid-clean them. The mere fact that *DLH* contemplates "boiling" his unit for 24 hr indicates that he is not cognizant of the many problems of inhibitor breakdown, hydrogen formation and acid concentration.

The savings to be achieved by acid-cleaning boilers are so great that cost of professional help most assuredly is within any operator's budget.

F G Feeley Jr, *New York, N.Y.*

Correction . . .

In the problem on water chemistry in August Power, makeup concentration in G Apfels' answer should be *3*, not *30*. How many readers caught this typographical error? With 3% makeup and assumed 10-F drop, number of concentrations actually goes as low as 1½.

Your November problems

Can we put lighting heat to work?

Our company, a midwest electric-equipment manufacturer, has grown rapidly during the past five years. More production space is needed and a new structure will go up adjacent to our present 3-story building.

Steam-heating system in present building badly needs modernizing. Lighting level is also definitely below par. We plan to air-condition both old and new buildings and completely revamp the lighting system.

Considerable heat is generated by proposed lighting level of 150 ft-c. If possible I'd like to use this heat to handle all or part of winter heating load, but remove it in the summer to keep the air-conditioning system's size within reason. What type of heating-cooling is best suited for this kind of arrangement? Have readers any design tips or experience to offer?—*ROP*

What's best way to test for dissolved oxygen?

Our plant laboratory is periodically called upon to run dissolved-oxygen tests on condensate and on feedwater leaving deaerating heaters. Up to now we have been content with a simplified Winkler test.

But some recent boiler-tube failures indicate that a closer watch is needed on dissolved oxygen in the system. We particularly want to check deaerator performance against the guaranteed oxygen residual of 0.005 cc per liter.

What test methods can we use? Will it pay us to invest in one of the many special instruments now available for measuring dissolved oxygen? At present we are sending samples to an outside laboratory for checking, but this is not a satisfactory long-range solution to the problem. What experiences have other readers had with dissolved-oxygen tests?—*CBC*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

Take these limitations into account

(1) Sulfamic acid must be inhibited for use on carbon steel. Most people prefer to use a compounded cleaner with both sulfamic acid and inhibitor.

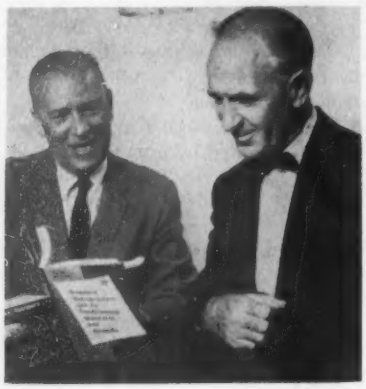
(2) The acid-water system should not be boiled, inasmuch as sulfamic acid hydrolyzes to ammonium bisulfate at these temperatures. This can react with the calcium originating from scale to form insoluble calcium sulfate. Recommended temperature is 160 F.

(3) Concentration of ¼ lb per gal mentioned may be inadequate to react with all scale present, unless boiler is very lightly scaled. About ½ lb of acid per gal is better.

W P Cooke, *Wilmington, Del.*

Want some help on plant problems? Send us any of your design or operating headaches for *Power* reader comment

Timely practical ideas to help solve



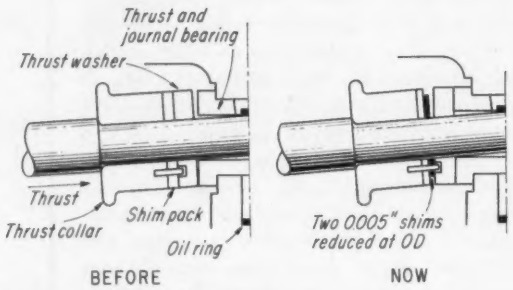
"Standards keep right on improving . . ."

beams Steve Elonka of POWER, left, as he and Quaid Minich of Borg-Warner Corp review the first copy of their new book—*Standard Refrigeration and Air Conditioning Q & A*—just off the press. The 16 pages of license requirements in Chapter 21 of this book are proof: more and more cities, states and Canadian provinces now require licensed operators for refrigeration and air-conditioning equipment.

Steam-license requirements have been surveyed before, by POWER, but this is the first refrigeration survey ever made showing types of equipment, tonnage and class of refrigerants requiring licensed operators.

Third volume in the expanding *Standard Q & A* library, this like the others is aimed at improving standards by (1) supplying typical questions on which license examination boards can base their exams (2) giving operators the basic and practical information they need to pass examinations and improve their job opportunities (3) keeping all energy-systems engineers abreast of standards and technology (one chapter is devoted to cryogenics) (4) providing a basic book for technicians and students in this fast-growing field.

You POWER readers can help us keep our data up-to-date. Let us know of any new refrigeration license requirements passed in your state.



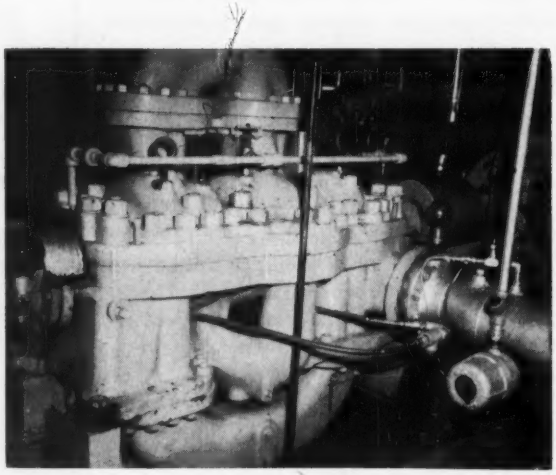
Now, our thrust bearing doesn't heat

Shown exaggerated in before-and-after sketches are thrust and journal of a turbine that drives a forced-draft fan. Our problem was limited contact of the surfaces under thrust, due to shaft and bearing wear and also to a minimum shaft deflection under load. Deflection thus acted on the combined thrust and journal bearing. When the tilt of the thrust caused the edges to break through the oil film, the high points contacted, and so we were constantly struggling with heating and wear.

We made the temporary repair shown in sketch. First we pulled off the bearing cap. Then we rolled out the bearing, making space to reduce the diameter of the two 0.005-in.-thick shims of the shim pack. This was quickly done with a pair of duckbill snips, and we were back in business.

We reasoned that, under thrust, the washer would have a chance to adjust itself parallel to the bearing flange. And we were right. Now there is less chance of thrust surfaces overheating until we can make permanent repairs.

E WITTMANN, *Villas, N.J.*



Float switch shuts down engine when packing glands leak

A simple way to keep packing-gland leaks from becoming a hazard on remotely controlled pumping units: connect the drain line from the glands into a central float chamber. Then hook up the chamber to a mercury switch. If chamber fills up, switch grounds out the engine.

Bottom of pot in photo has an outlet where the valve can be throttled to

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

allow slight leakage through the packing for lubrication. But as soon as leakage becomes excessive, the collected liquid will raise the float. The mercury switch then grounds the circuit on the pumping engine's magneto, or if you're using an electric motor, cuts off its switch.

H HESS, *Houston, Texas*

EDITOR'S NOTE: Wouldn't it be more practical to connect the float to a warning signal in the remote-control station instead of letting it stop the pump? Operator could then investigate and tighten the gland without shutting down. Or if a mechanical seal failed completely, he could start up a standby unit, then shut down without interrupting process flow.

Do any of you readers have suggestions? Let me know if you do.

STEVE ELONKA

Let's get this right . . .

The words *supersonic* and *ultrasonic* are *not* interchangeable—they mean two different things. According to ASA Standard S1.1—1960: "*Ultrasonics* is the technology of sound at frequency above the audio range. *Supersonic* is the general subject, covering phenomina associated with speed higher than the speed of sound as in aircraft, projectiles traveling faster than sound. This term was once used in acoustics synonymous with ultrasonics. Such usage is now deprecated."

From Webster's Dictionary: "*Ultrasonics* pertains to vibrations and waves whose frequencies are greater than those which affect the human ear, that is, greater than about 20,000 cps. *Supersonic* designates a speed exceeding that of sound in air."

L GREIF, *New York, N.Y.*

Did you know . . .

that 30 instrument manufacturers offer courses in instrumentation? See Sept POWER for names, addresses.

What would you have done?

Several years ago I was fire-room second assistant engineer aboard a freighter running down to South America. One trip on the Plata River we took on boiler water in the little port of San Fernando, Argentina. It was well water and turned out to be highly alkaline—up to 1000 ppm. But at sea we were too short of water to give the boilers a bottom blow. Fact is, we just barely made New York, and by the time we hit home port, our boilers were badly scaled. How to get rid of that scale quickly? We were already behind our sailing schedule.

After dumping the boilers and seeing that scale, I quickly filled them up again using the ejector to have the water as hot as possible. The boilers were still hot. Then I closed the gage cocks and air vents. I had the firemen tie coco floor mats over the mud-drum handhole plates of each boiler so no one could possibly be scalded.

I knocked in each mud-drum plate. The tons of hot water gushed out in torrents as air rushed in to replace the partial vacuum. And as air rushed in, it surged its way up through the water to the steam drum, thus loosening most of the heavy scale which washed out with the water. We finished the job by sticking a fire-hose nozzle down through each tube from the steam drum when the boilers had cooled enough. What would *you* have done?

G WARMAN, *Wantaugh, N.Y.*

Let's take a second look at shaft whip

E Wittmann's prevention of pump-shaft whip (POWER, June 1961, p 228) may lead some users astray. While he has undoubtedly corrected this particular problem, his solution could be quite dangerous in the long run. The manufacturer probably used a self-aligning bearing for a reason, and shaft design depends on angular freedom at the inboard end.

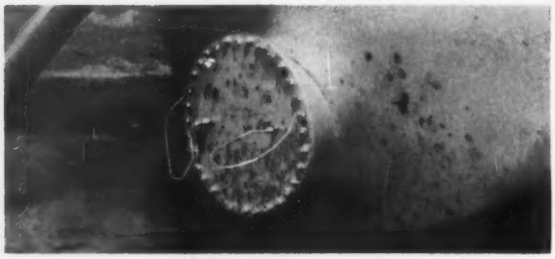
Shaft whip may be due to hydraulic unbalance because of low-flow operation. In this case, solution would be bypass to produce a higher gross flow.

Wittmann has created a very high moment and bending stress in the shaft at the inboard bearing. Shaft failure could easily result. He might better try a new shaft with a very heavy section between bearings. This would cut down overhung deflection and packing difficulties, still allow a self-aligning bearing.

I don't think a user should ever modify rotating equipment of this sort without consulting the manufacturer. He cannot know the design intricacies of these shafts and bearings, so he may be buying more trouble than he had.

J PEARSON, *Fair Haven, N.J.*

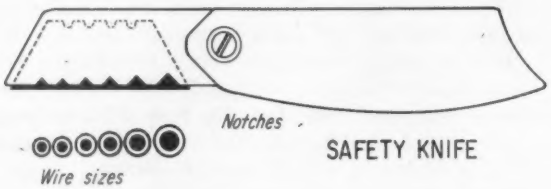
More **practical ideas**



Use manhole cover for anodes

Photo shows large vessel for storing corrosive fluids. To prevent corrosion, the manhole cover at the bottom is used for anodes. Install the setup by placing the anodes in the tank bottom, then connecting them to the outside with copper tubing inserted in holes previously drilled into the cover. In this way you can easily inspect or change the anodes by removing the cover when tank is empty. We find this an extremely practical setup.

H HESS, *Houston, Texas*



This knife is safer

Safety knife can easily be made to cut wire and cable insulation to uniform depth. You won't cut into the copper strands, as happens when you're using a pocketknife. And it's always a good idea to have a special tool for the job.

First remove the blade. Assemble the 2-sectioned handle with the screw. Place handle in a vise and use a triangular file to make a number of 45-deg notches of various depths along the edge to accommodate the various size wires.

F LETTINO, *Long Island City, N.Y.*

Draft gage saves the day for me

I was called to check the capacity of one plant's ID fan. I had a pitot tube in my bag and my plan was to traverse the stack to measure gas velocity since it was the only straight run of duct available. A fine idea except the velocity head in the stack was so low I needed an inclined manometer to read it. This I didn't have! We looked all around the plant but couldn't turn one up.

But in the control panel was a furnace-draft gage. This was a standard instrument that could be hooked up as a differential draft gage. We used it on our pitot tube and it worked fine!

L A WATSON, *Atlanta, Ga.*

My biggest boner

My first headache as master mechanic in a southern textile mill was also my first big boner. At three am a sleepy mechanic called about a broken shaft on a centrifugal chilled-water pump that supplied half of the mill's air conditioning. It was July, so that air conditioner had to be started next morning. To expedite the repairs I told the mechanic to dismantle the pump while I was on my way.

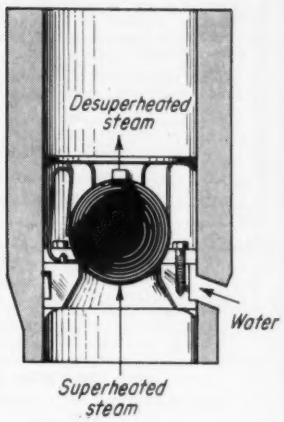
We machined a new shaft and reassembled the pump. The sleepy mechanic, who had worked all night, assured me he had marked the pump impeller before pressing it off the broken shaft.

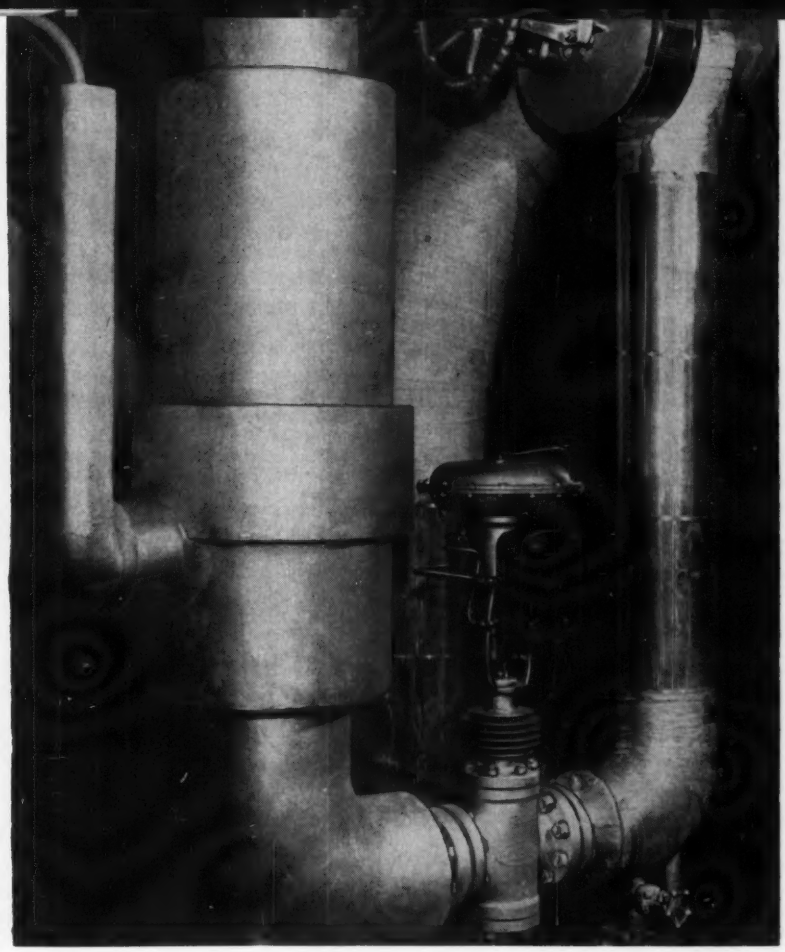
But the assembled pump refused to pump and started running hot. We loosened the packing and blew some grease out of the bearings. It still wouldn't pump and it still ran hot. We changed the packing; no change in the pump. It was almost noon and the mill manager started breathing down my neck. He said they would have to let half the production force go home if that pump wouldn't work.

At my wit's end, I turned to my sleepy-eyed mechanic and asked him again about the match marks on the impeller. Then—he admitted that he had marked it *after* he pressed it off the broken shaft. Quickly we dismantled the pump, pressed the impeller off the shaft, turned it around and reassembled it. Sure enough, the pump ran like a million dollars.

My biggest boner taught me two things: (1) always match-mark the parts before disassembly and (2) never take the word of a sleepy-eyed mechanic early in the morning.

D B WILSON, *Atlanta, Ga.*





STEEL BALL floats on steam flow, above, maintaining required pressure drop across vertical desuperheater station, right. Design turndown ratio is 50:1 at 125 psig

High-turndown desuperheater at work in large steam station

Middletown Station of The Hartford Electric Light Co uses 125-psig steam in oil-burner atomizers as well as for air preheaters and fuel-oil and building heating. This steam normally comes from the 15th stage of their main turbine, but when demand is high, available pressure drops. Then cold reheat steam substitutes and the desuperheater station comes into service.

Inlet steam arrives at the desuperheater at 117.8 psia, 540 to 550 F; it's desuperheated to 400 F with a constant pressure loss of 3 to 4 psi regardless of flow.

Steam demand from this desuperheater station varies widely—the swing from a high of 25,000 lb down to 500 lb per hr is usual. This means a turndown ratio of 50:1. Sometimes operating needs go as low as 250 lb per hr (100:1 turndown); occasionally they drop to zero for short periods. In any case, the desuperheater (which was made by Copes-Vulcan Div of Blaw-Knox Co) is untouched by its operators—even after cutting out at zero, it's ready to go back on the line when normal flow is restored.

How does the desuperheater station operate through such a wide range? Briefly, the area of this vertical desuperheater's steam orifice automatically varies with required steam flow. A steel ball rests on a ring seat in the desuperheater and is held radially by Inconel springs and guides. Steam pressure lifts the ball off its seat to a point where its weight is exactly balanced by steam pressure and flow through the orifice. As demand changes, ball position alters vertically, which changes the area of the orifice. So flow can go from zero to the maximum design condition with essentially the same pressure drop through the desuperheater.

Water enters through an annular chamber surrounding the ball seat (point of maximum steam velocity). As steam passes through the restriction between the ball and its seat it has an aspirating effect, drawing the cooling water in and mixing it intimately with the steam. Water is therefore entrained at the point of highest steam velocity and turbulence over the desuperheater's entire range.

Cooling water for this installation comes from condensate-pump discharge at an average 250 psig and 90 F. But water pressure can vary as much as 40 psig, and the desuperheater can handle the lowest water pressure ever when it's combined with the highest steam pressure.

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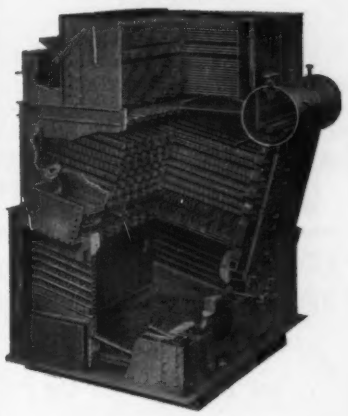

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Evaporation Rate, lb. per hr. actual	
(normal power)	26,500
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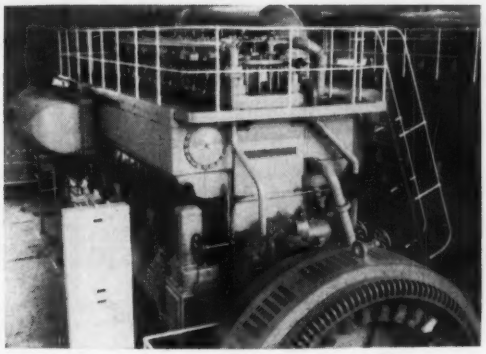
6 cylinder, 2 cycle
225 RPM



Generator—Westinghouse
2112 KVA, 3/60
2400/4160 Volts
30 KW Exciter

Complete with fuel pumps, air starting equipment, oil booster pumps and exhaust silencers.

We also carry a large stock of Turbine Generators. Let us have your requirements for any size unit.

Cable Address: CHASWEAVER

CHARLES WEAVER, INC.
19701 JAMES COUZENS HIGHWAY
DETROIT 35, MICHIGAN

Telephone: BRoadway 3-1900

Circle 518 on Reader Service Card

COMPLETE 1250 K.V.A.–1000 KW DIESEL GEN. SET

420 VOLTS — 3 PHASE — 50 CYCLE 4-WIRE

ENGINE: GM 16-278A—seria 11691—1700 HP —16 cylinder—8¾" x 10½". Complete with hydraulic governor & overspeed trip.

ALTERNATOR: Electric Machinery Co.—420 volts, 3 phase, 50 cycle, 4-wire, 0.80 P.F.—720 RPM. Complete with all switchgear, air starting compressor, gauge board, heat exchangers, all pumping equipment. Unit packed for export. Immediate delivery.

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 LEXINGTON 9-1900

Circle 519 on Reader Service Card

---

30 H.P. U.S. VARI-DRIVE TYPE VEU-GH (20 units)

Gear Ratio—2.29 450/1000 rpm

Excellent condition as removed from service
MOTOR SPEC: 30 H.P.—3/60/220/440V.
1800 R.P.M., FRAME: 54-365-50
CODE "F" — DESIGN — B
WITH VARITROL PNEUMATIC CONTROL

DRY TRANSFORMERS—

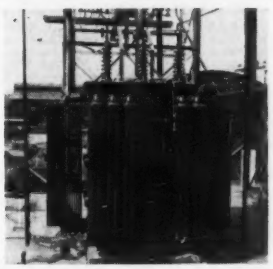
Single Phase 450V/115V. Mfgrs. Standard & G.E.

50 KVA (20 ea.) 37½ KVA (25 ea.)
25 KVA (35 ea.) 15 KVA (40 ea.)

Write for our New Catalog

D. R. GLAZER CO. Dept. P1
45 NASSAU ST., N.Y. 5, N.Y. BE 3-5033

Circle 520 on Reader Service Card



(1) 7500 KVA WESTINGHOUSE TRANSFORMER—1949

Primary 69300/67650/66000/64350/62700 Volts—Secondary 13800 Volts, 3 Phase, 60 Cycle type—SL, Class OA, Imp 8.4%—S/N 4089566 complete with overhead structure, bushings, strain insulators, fused disconnects, etc.

Liquidating former Phoenix Steel Corp. Plant at Harrisburg, Pa. Dozens of other transformers 2400 Volt Primary 220/440 secondary 60 Cycle—666 KVA to 25 KVA.

AT FRACTION OF REPLACEMENT PRICE

WRITE — PHONE — WIRE

LIPSETT DIVISION
Luria Brothers & Company, Inc.
915 South Front Street
P.O. Box 1151
Harrisburg, Pa.

CEDAR 6-5988

Arnold L. Landesberg—Project Manager

Circle 521 on Reader Service Card

ELECTRICAL POWER EQUIPMENT

SLIP RING MOTORS

HP	RPM	MAKE	VOLTS	TYPE
2500	257	G.E.	6600	MT-28
1000	1200	Al.-Ch.	4000	ANY
1000	900	Al.-Ch.	2300	ANY
700	720	G.E.	440	I-M
600	1800	G.E.	4160	M-6345
500	1200	G.E.	440	M-6345Z
400	1200	West.	2300	CW
400	720	G.E.	440	MT-573Y
350	1800	Al.-Ch.	2300	ARYW
300	900	G.E.	440	IM-17
300	450	G.E.	440	IM-16
250	600	West.	2300	CW-1000
200	514	West.	2300	CW-950A

MOTOR GENERATOR SETS

KW	MAKE	A.C.V.	D.C.V.
1750	G.E.	4160/2300	250/300
1250	West.	4160/2300	250
1000	West.	4160/2300	250
750	G.E.	4160/2300	250
600	G.E. (3 unit)	2300/440	125/250
500	G.E.	2300	250
400	Al.-Ch.	2300/440..	125/250
250	G.E.	2300	250
200	G.E.	2300	250
150	West.	440	250

D. C. MOTORS

HP	RPM	MAKE	VOLTS	TYPE
1500	300	West.	250	TEFV
850	250/500	West.	250	QM
600	250/500	G.E.	600	DBL. ARM.
500	210	G.E.	250	MCF
400	1150	REL.	250	T-1970
400	300/900	G.M. (2)	250	D4D
300	575/1150	West.	250	CB-500
200	700	West.	250	SK-201
150	280/1000	G.E.	250	MCF
150	1150	G.E. (2)	250	RC-37
150	400/530	West.	250	SK-201
100	400/800	G.E.	250	MPC-6
100	575	G.E.	250	CD-147

Write for current complete stock lists on electrical power equipment you need or send your list of surplus and used equipment for our offer.

50 YEARS 1910 - 1960 SERVICE TO INDUSTRY

Phone CAnal 6-2900

CHICAGO Electric Co.

1320 W. CERMAK ROAD • CHICAGO 8, ILL.

Circle 522 on Reader Service Card

RE-NU-BILT ELECTRICAL EQUIPMENT

53 YEARS SERVICE

MOTOR GENERATOR SETS

Qu.	KW	MAKE	RPM	AC VOLTS	DC VOLTS
2	4800	G.E.	450	2300/4600	250/300
1	2500	WHSE.	720	2300/4160	600
1	2100/2100	G.E.	450	2300/4600	250/300
2	1750/2100	G.E.	514	2300/4600	250/300
1	2000	G.E.	514	2300/4600	600/666
1	1500	G.E.	720	13200/6600	600
1	1250	WHSE.	720	2300/4000	600
1	1000	G.E.	900	2300/4000	600
1	1000	G.E.	900	6600/4000	260
1	1000	G.E.	720	2300/4000	275
1	500	G.E.	900	2300/4600	250
1	500	G.E.	900	440	250/125
2	300	G.E.	1200	2300	275
1	300	WHSE.	1200	2300/4100	600
1	200	G.E.	1200	2300/4160	250

FREQUENCY CHANGER SETS

Qu.	KW	MAKE	FREQ.	VOLTAGES
1	12500	WHSE.	60 To 25	13200-13200
1	5000	G.E.	60/50/60	11000-6600
1	2500	G.E.	60/24/60	2400-2400
1	2000	G.E.	60 To 25.7	4600-11000

3 PHASE 60 CYCLE MOTORS SLIP RING

Qu.	HP	MAKE	TYPE	VOLTS	SPEED
1	1750	G.E.	M-570BS	4800/2400	1890
1	800	WHSE.	CW	550/2200	1776
1	600	WHSE.	CW-32D	440	1778
1	600	WHSE.	CW	440	850
1	550	WHSE.	CW	440	252
1	500	WHSE.	CW	2300	881
1	500	WHSE.	CW	550/2300	350
1	300	AL. CH.	ANY	2200	720
1	300	GEN. EL.	MTP-561	2200	1760

SQUIRREL CAGE

Qu.	HP	MAKE	TYPE	VOLTS	SPEED
3	1500	G.E.	K.D.P.	2300	3580
2	500	WHSE.	CSP-583H	D.P. 440	3600
1	500	AL. CH.	ARW-D.P.	2300	3600
3	500	Whse.	CS-1216	2200	500
1	400	AL. CH.	AW30CS6,	D.P. 440	1770
1	400	WHSE.	CS7151	6600	3565
1	300	Cont.	NL636,	D.P. 440	1780

OUTDOOR G.E. METAL CLAD SWITCHGEAR

600 V. 3 POLE, A.C.B.

1—3000 AMP., AL-2-75, ELEC. OPER
1—1000 AMP. AL-2-50, MANUAL
4— 800 AMP, AL-2-50 MANUAL
1— 400 AMP., AL-2-50 MANUAL
3—SPARE COMPARTMENTS

PUMPS — MOTOR DRIVEN

4—600 G.P.M. Gould, Figure 3360, 8 Stage, 2310 Ft. Head, 1000#, 3550 RPM, Each coupled to 500 HP 3-60-3350 RPM D.P. Sq. Cage Motor

2—WHSE, Type CSP-583H, 440 volt

1—Allis Ch. 2300 V.

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.
Phone: OL 3-3334—N.Y.C. RE 2-7150

Circle 523 on Reader Service Card

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
750	El. Machy.	Synch.	480	514
700	G.E.	Slipring	2300	400
700	G.E.	Slipring	2300	514
600	G.E.	Synch.	2300	514
600	G.E.	Synch.	480	900
600	Elliott (2)	Sq. Cage	2300	900
600	Whse.	Slipring	2300	360
500	G.E.	Slipring	2300/4000	514
500	G.E. b.b. (2)	Synch.	2300/440	1200
450	Allis Ch.	Sq. Cage	2300/440	720
400	G.E. Vertical	Sq. Cage	2300	720
400	Allis Ch.	Slipring	2300	900
400	Whse.	Sq. Cage	2200	514
400	Marathorn (2)	Sq. Cage	2300	3600
400	G.E.	Slipring	2200/440	600
400	Whse.	Sq. Cage	440	1200
350	Allis Ch. (2)	Slipring	2300	450
350	G.E.	Slipring	440	900
350	El. Machy.	Synch.	2300	900
300	G.E.	Slipring	220/440	514
250	G.E.	Sq. Cage	440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	Whse.	Sq. Cage	2300/440	600
250	Whse. (4)	Slipring	2300/440	600
200	G.E.	Slipring	550/440	1200
200	Allis Ch. TEFC	Sq. Cage	440	900
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	600
200	G.E.	Slipring	2300	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2200/440	720
200	G.E.	Sq. Cage	2300	450
150	Whse. b.b.	Sq. Cage	440	1800
150	Whse. XP	Sq. Cage	440	3600
150	G.E. (4)	Slipring	2200/440	600
150	Whse.	Slipring	220/440	1200
150	G.E.	Sq. Cage	2200/440	600
125	Star b.b.	Sq. Cage	220/440	900
125	A.C. TEFC	Sq. Cage	220/440	1800
125	El. Machy (2)	Synch.	220/440	400
125	G.E. TEFC	Sq. Cage	2200	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
125	G.E. (2)	Slipring	220/440	514
100	L. Allis TEFC	Sq. Cage	440	900
100	Star b.b.	Sq. Cage	220/440	600
100	Allis Ch.	Slipring	2300/440	600
100	G.E. TEFC	Sq. Cage	220/440	1200
75	A.C. TEFC	Sq. Cage	2300/440	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
350	G.E.	MPC	250	900/1200
250	Cr. Wh.	101-E	230	1150
200	Whse. b.b.	SK	250	287/575
150	Rel. TEFC b.b.	2650-F	230	850
125	G.E.	CD-173	230	575/1150
100	Reliance b.b.	1050-T	230	600/1200
100	Elliott b.b. T.E.	JH-FE	230	1150
100	El. Dyn. b.b. (2)	30-S	230	450/1200
75/100	Whse.	SK-191	230	300/900
60	G.E. TEFC b.b.	CD-135	230	1150
40/50	Whse b.b.	SK-173	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input	Output V
600	Allis Ch.	440 AC	250 DC
300	G.E.	440 AC	250/350 DC
250	Whse.	2200/440 AC	250 DC
200	Whse. synch.	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
125	Gen. Elec.	2300/4000 AC	250 DC
100	Delco b.b.	220/440 AC	120/240 DC
75	Whse. Synch.	220/440 AC	250 DC
75	Elec. Prod.	220/440 AC	125 DC
50	G.E.	220/440 AC	250 AC

Arthur Wagner Co.

Certified

MO nrce 6-7409
1435 W. RANDOLPH ST
CHICAGO 7, ILLINOIS

Circle 525 on Reader Service Card

TRANSFORMERS—60 CYCLE

QU.	KVA	MAKE	TYPE	PHASE	VOLTAGE
2	3000	Moloney	TCB	3	7200-4160/2400
2	3000	G.E.	OA-T	3	26,400-4160/2400
3	100	G.E.	Pyranol	1	2400/4160-240/480
2	1000	Mot.		3	13800-4000/2300
3	300	G.E.	K.S.T.Q.	1	4150-2400
1	300	Penna.	OA Askarel	3	12,470Y/7200-240
3	200	Amer.	C.C.	1	4160/7200-240/480
3	200	G.E.	HS-W2S	1	2400/4160-240/480
3	75	G.E.	H-form KF	1	2400/4160Y-120/240
1	75	West.	DS Dry	3	480/240-240/120
3	50	Niagara	Dry-air	1	2400/4160Y-120/240
3	50	Harrison	Dry-air	1	2400/4160Y-220/440

MOTOR GEN. SETS

QU.	KW	MAKE	SPEED	D.C.	A.C.
1	1000	West.	720	600	2300/4160 S.R.
1	400	West.	900	250	3 unit 4160 V. syn.
1	300	G.E.	1200	250	2300/4160 syn.
1	300	Al. Ch.	1200	125/250	3 unit 440 syn.
1	175	West.	1200	125	4160 syn.
1	100	West.	900	230	4160 syn.
1	45	G.E.	1170	30	440V Sq. Cage
1	300	West SK	900	250	syn. 480 volts

D.C. MOTORS—230 VOLT

QU.	HP	MAKE	SPEED	TYPE
1	350	G.E.	1200	ped. type
1	90	G.E.	1750	CDM
1	30	West.	1750	SK-113
1	30	G.E.	2200	CD-85
1	15	Crocker Wh.	1750	CCM, TEFC

SLIP RING MOTORS

QU.	HP	MAKE	SPEED	TYPE	VOLTS
1	500	G.E.	450	MT-422Y	2200
1	450	West.	1800	CW 4-30-9	220
1	350	West.	1800	CW	2300
1	200	West.	385	CW	440
3	150	Al. Ch.	1760	AY-RW	2300
2	150	G.E.	590	1-16	4000
1	100	West.	1770	TEFC B.B.	220/440
1	75	West.	1160	CW 607	220/440
1	75	West.	600	CW 774C	220
1	50	G.E.	570	MT 552	220/440

SQUIRREL CAGE MOTORS—3 phase—60 cyc.

QU.	HP	MAKE	SPEED	TYPE	VOLTS
1	300	Al. Ch.	1200	TRW	2200
1	300	G.E.	1800	63368 B.B. Drip	4160/2400
1	275	G.E.	1180	KT 559BS	2200
1	75	G.E.	1790	KTEFC B.B.	2300
1	75	Cont.	1780	K 6323-S XP B.B.	440
2	100	Cont.	3570	NP 585-S XP B.B.	440
2	250	G.E.	3563	NP5058X XP B.B.	440
2	150	G.E.	875	KT 552Y	440
1	50	G.E.	3530	KP 405Y Vert.	220/440
1	50	Cont.	3530	NP 445X XP B.B.	220/440

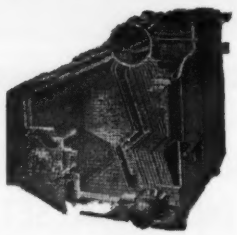
MOTORS—SYNCHRONOUS 3 ph, 60 cyc.

HP	SPEED	MAKE	TYPE	VOLTS
825	900	West.		2300
400	450	West.	HR	440
300	720	El. Mh. TEFC		2300
200/100	720/360	West.		4150
150	3600	G.E.	TS 956Y drip	2300
150	1800	G.E.	TS	220/440
150	900	West.		220/440
125	900	G.E.	TS 7536	2200
125	600	G.E.	TS 7641	2300
75	1200	Cr. Wh.	ALT B.B.	220/440

FOR POWER
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK LONGACRE 5-2727
PHONE NEW JERSEY UNION 3-2600

Circle 524 on Reader Service Card

BOILERS NEW UNASSEMBLED



#Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (Illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

Pelnik-Loconti Industrial Supply, Inc.

315 Oriskany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE 2-4513

Circle 526 on Reader Service Card

DIESEL ENGINE

1 HEAVY DUTY NORDBERG

Type TSM—model 32118—1700 HP @ 180 RPM — 21½" x 29". Unit complete with all pumps and coolers. Can be used for generator drive, producing 2400 HP @ 225 RPM. Equal to new. Presently in Maritime Academy.

THE BOSTON METALS CO.

313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

Circle 527 on Reader Service Card

DIESEL GENERATOR SETS—3 ph., 60 cy.

QTY	KVA	MAKE	VOLTS	RPM	YEAR
2	1000	Hamilton	2300	600	1945
3	1250	G.M.	2300	720	1945
2	250	G.M.	220/440	1200	Rebuilt '60
1	375	G.M.	220/440	1200	1945
1	412	Worth.	240	600	1949
1	150	Superior	240	1200	98% New
1	150	F.M.	2300	360	1940
1	37.5	Buda	240	1200	98% New
1	31.5	Cummins	240	1200	98% New

STEAM TURBO GENERATORS—Non-Cond.

KW	MAKE	VOLTS	STEAM	EXHAUST	YEAR
5000	G.E.	2400/4160	825#	265/20	1954
3000	G.E.	2300	200#	15	1923
3500	G.E.	2300	250#	20	1955
1000	G.E.	2300	400#	90/125	1945
1000	Elliott	480	325#	145/20	1950
750	G.E.	480/4800	165#	15	Late
300	Allis	2300	175#	3/20	Late
250	Allis	240	140#	6/20	1948
125	Allis	240	140#	6/20	1948

STEAM TURBO GENERATORS—Condensing EXTR.

KW	MAKE	VOLTS	STEAM	LB.	YEAR
5000	G.E.	2400/4160	825#	265	1954
3000	G.E.	2300/4000	250#	15	1937
3500	G.E.	4800	825#	265	1954
3000(2)	G.E.	2300/4160	400#	—	1940
1000(2)	Elliott	480	155#	—	1948
750	West.	480	175#	15	1940
600(2)	G.E.	600	150#	10	1930
400(2)	Elliott	480	175#	—	1956
200	Worth.	480	200#	50	1947

PACKAGE BOILERS

Q	HP	MAKE	W.P.	FIRING	YEAR
4	500	Cl. Bk.	200	Oil	1942
1	200	Erie	160	#6	1951
1	150	Cyclotherm	150	#6	1947
1	150	Cl. Bk	15	#6	1936
1	70	Ames	15	#2	1951

AIR COMPRESSORS

CFM	PSI	MAKE	TYPE	H.P.	VOLTAGE	RPM	YEAR
7550(2)	24/30	I.R.	XHE	600	3/60/4160	300	1948
4000	125	I.R.	PRE	700	3/60/2400	164	1946
1853	125	Worth.	DC-2	300	3/60/2300	277	1946
2000(2)	100	Fuller	Rot.	300	3/60/2300	600	1942
676(2)	125	C.P.	OCE	125	3/60/480	277	—
515(4)	125	I.R.	40	100	3/60/440	870	1940/50
494	125	I.R.	XRB	75	3/60	277	—
464	100	I.R.	ES-1	75	3/60	300	1950
368	100	I.R.	ER-1	60	3/60	277	Late

"Everything from a Pulley to a Powerhouse"

THE O'BRIEN MACHINERY CO.

• Telephone BAldwin 8-1480
• Cable Address OBRIEN PHILA.

MERCHANTS—CONSULTING ENGINEERS—EXPORTERS

OFFICES IN MEXICO, BRAZIL, COLOMBIA, ARGENTINA, PANAMA

Se Habla Español

1937 W. CLEARFIELD ST., PHILADELPHIA 32, PA.

Circle 528 on Reader Service Card

POWER EQUIPMENT CO.

BARGAIN PRICES

ON NEW and GUARANTEED Rebuilt MOTORS!

Special purchase of the following 220 or 440 Volt—60 Cycle—3 phase—New Motors—In Crates—Inquire for Special Bargain Prices

Qty.	HP	Make	Type	Speed
1	400	Al. Chal. S.B. Drip	AW-30CS6	1800
1	300	Marathon. B.B. Drip	TDC-586	1800
1	300	Al. Chal. S.B. Drip	AW-26-J86	1800
1	250	West. S.S.B. Drip	CSP-582H	3600
2	200	U.S. B.B. Splash	SC-587	1800
3	200	Century S.B. Drip	SC-586	1800
3	200	Wagner. S.B. Drip	RPI-585	1800
3	150	Century S.B. Drip	SC-585	1800
4	150	Ideal S.B. Drip	A-584	1800
6	100	Reliance T.E.F.C.B.B.	AA-445U	1800
1	100	Al. Chal. T.E.F.C.B.B.-XP	AZZ-23ES	900
3	60	Ideal. B.B. Drip	A-504	1200
4	50	Marathon B.B. Splash	ZTDR-365U	1800

Slip Ring Motors—220 or 440 Volt—60 Cycle—3 phase—Guaranteed Rebuilt

Qty.	HP	Make	Type	Speed
1	300	G.E.S.B. Open	IM	1200
1	300	G.E.S.B. Open	IM	900
1	300	West. S.B. Open	CW	600
1	250	G.E.S.B. Open	IM	600
1	200	West. S.S.B. Open	CW-871C	1800
1	200	G.E.S.B. Open	IM	1200
1	200	G.E.S.B. Open	IM	900
1	200	G.E.S.B. Open	IM	720
1	200	G.E.S.B. Drip	M	600
1	150	L.A.B.B. Splash	FH-118	1200
2	150	G.E.S.B. Open	IM	1200
1	150	G.E.S.B. Open	IM	900
1	150	G.E.S.B. Open	IM	720
4	150	G.E.S.B. Open	IM	600

Motor Generator Sets—Guaranteed Rebuilt

KW	Make	AC Motor	Speed
100	West.—230 Volt—B.B.	220 or 440 Volt	1800
100	G.E.—230 Volt—B.B.	220 or 440 Volt	1800
60	C.W.—230 Volt—B.B.	220 or 440 Volt	1200
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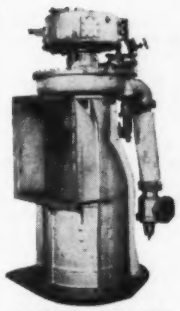
20 TURBINE DRIVEN FORCED DRAFT BLOWERS

mfg. by B. F. Sturtevant Co.



With turbine throttle pressure of 575# dry saturated steam and 15# back pressure, the following performance table applies:

CFM	STATIC PRESSURE	RPM	H.P.	LBS./HOUR
29,500	35"	5540	250	8250
22,500	21.50"	4280	117	3978
19,350	14.80"	3600	69	2829
22,100	8.80"	3385	57	2508
21,000	7.75"	3220	48	2208
14,750	8.95"	2780	32	1760
14,000	8.05"	2640	27	1620
15,000	4.00"	2310	18	1260

PRICED TO SELL

$950.00 EACH

The blowers will deliver heir rated capacity at 460# dry saturated steam and 15# back pressure. Units are vertical, with 30¼" alloy steel propeller fan. V-C-7 turbine—built to high Navy standards. Each wheel is machined from a single forging with the buckets milled into the rim. Spare parts furnished with each fan.

The BOSTON METALS Co.

313 East Baltimore Street, Baltimore 2, Maryland
CURTIS 7-5050 LEXINGTON 9-1900

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2 Westinghouse Turbo Generator Sets

312 KVA each—Initial Stm. 150 PSIG—Exhaust Stm. 5 PSIG—Electrical Conditions 3/60/2400V Surface Cond.—Westinghouse Switchboard, fully metered—New in 1947—$50,000 complete—will consider terms.

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Hotel Del Coronado, Coronado, Calif.

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STEAM SPECIALTIES
PUMPS — FANS

• LARGE SELECTION — NEW AND USED

1. B. & W. Pack. Boiler, Oil	122,250#/Hr.	634 psi
2. B. & W. Pack. Boiler, Oil	60,000#/Hr.	475 psi
3. B. & W. Pack. Boiler, Oil	44,500#/Hr.	475 psi
4. B. & W. "FF" Boiler, Oil/Gas	35,000#/Hr.	450 psi
5. Springfield Str. Tube	60,000#/Hr.	250 psi
6. Comb. Eng. "VU"	85,000#/Hr.	300 psi
7. Foster Wheeler, Oil	30,000#/Hr.	250 psi
8. Wickes Type "A" Oil	18,000#/Hr.	160 psi
9. Erie Type "C"	45,000#/Hr.	100 psi
10. Comb. Eng. "M2" Oil	6,000#/Hr.	375 psi
11. Cl. Brooks Pack. Oil	250 HP	150 psi

WABASH POWER
•EXPORT•

• EXPERIENCED ENGINEERS TO ASSIST YOU

12. Cyclotherm Pack. Oil/Gas	100 HP	125 psi
13. Cyclotherm Pack. Oil	60 HP	150 psi
14. Cyclotherm Pack. Oil/Gas	150 HP	150 psi
15. Vapor Clarkson, Oil	165 HP	300 psi
16. H.R.T. Boilers	300 & 150 HP	125 psi
17. Erie City Economic	200/400 HP	125 psi
18. 600 KW, G.E. Turbo-Gen. N. Cond. 450 psi—3/60/480v./3600 RPM		
19. 750 KW Westinghouse Gen. Cond. 250 psi—3/60/450v./1200 RPM		
20. KW Worthington Gen. Non. Cond. 190 psi—3/60/450v./3600 RPM		
21. 1800 KW G.E. Turbo-Gen. Cond. 410 psi—3/60/1735v./3600 RPM		
22. 4600 KW G.E. Turbo-Gen Cond. 410 psi—3/93.3/2700v./5700 RPM		

WABASH POWER EQUIPMENT CO.

3300 W. PETERSON AVE., CHICAGO 45, ILL. TEL. IN 3-0303

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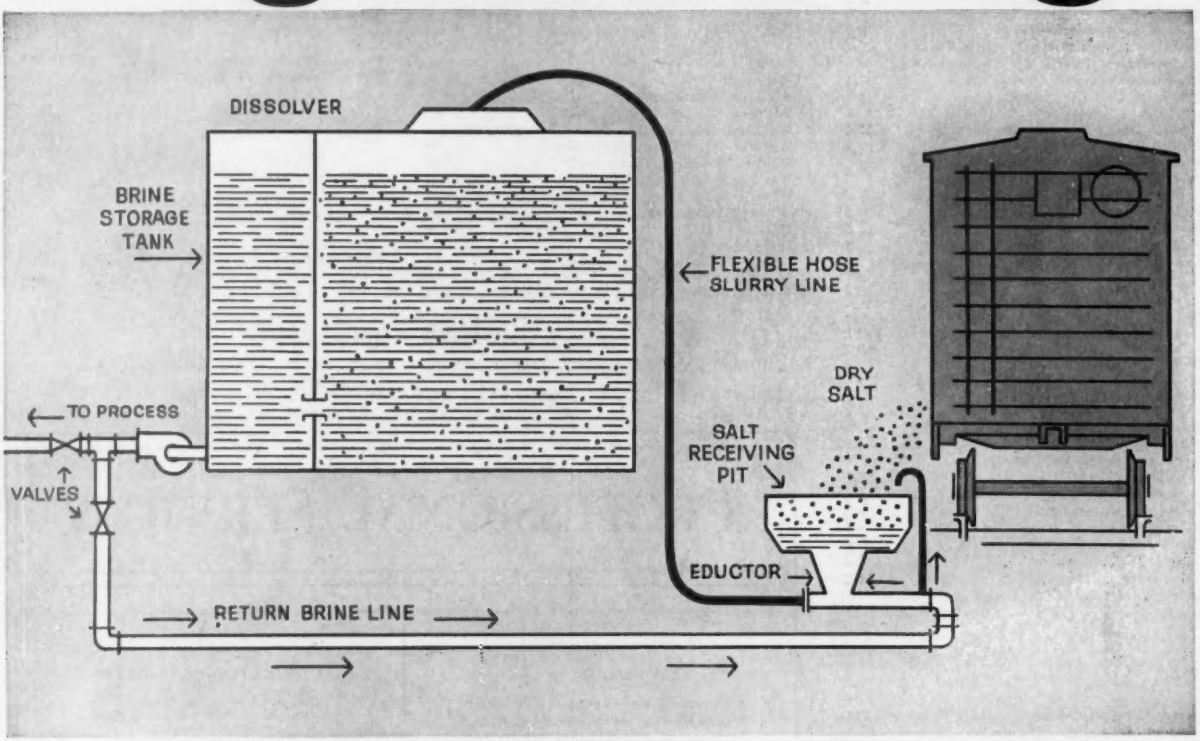
salt engineering



New hydraulic salt-handling system pays for itself in one year

A food-specialties manufacturer used to buy evaporated salt in bags. They used a batch mixing process to combine the salt with other ingredients to produce a patented product. Lugging the salt from boxcar to the plant, storing it, then dumping into mixing vats was time-consuming, expensive and took up valuable warehouse space.

In an effort to speed up and economize on the operation, this manufacturer called in an International Salt Company Technical Service Representative. He recommended simplifying the mixing process by installing a Storage Brinomat* Dissolver outside the plant. The Dissolver automatically supplies sparkling, pure brine to the process *continuously*.

He also recommended buying less expensive bulk salt by the carload and delivering it to the Dissolver by a hydraulic handling system. In this system, designed by International's Technical Service Department (see diagram above), a power scoop pushes salt from the cars into a receiving hopper feeding an eductor system. There the salt is mixed with brine from the Dissolver and educted as a slurry of saturated brine and undissolved salt to the Dissolver.

Efficiency and economy have been remarkable. After one year of operation the plant manager informed International that the entire system had already paid for itself!

Hydraulic handling systems can be designed to unload, move and store any amount and type of salt—rock or evaporated.

With over fifty years' experience, International is uniquely equipped to offer assistance on all phases of salt or brine usage. Even if you're satisfied with your present operation, perhaps it *could* be improved. Why not review your operation with an International Technical Service Representative? Salt is his business. Write International Salt Company, Clarks Summit, Pa., or call our nearest district office.

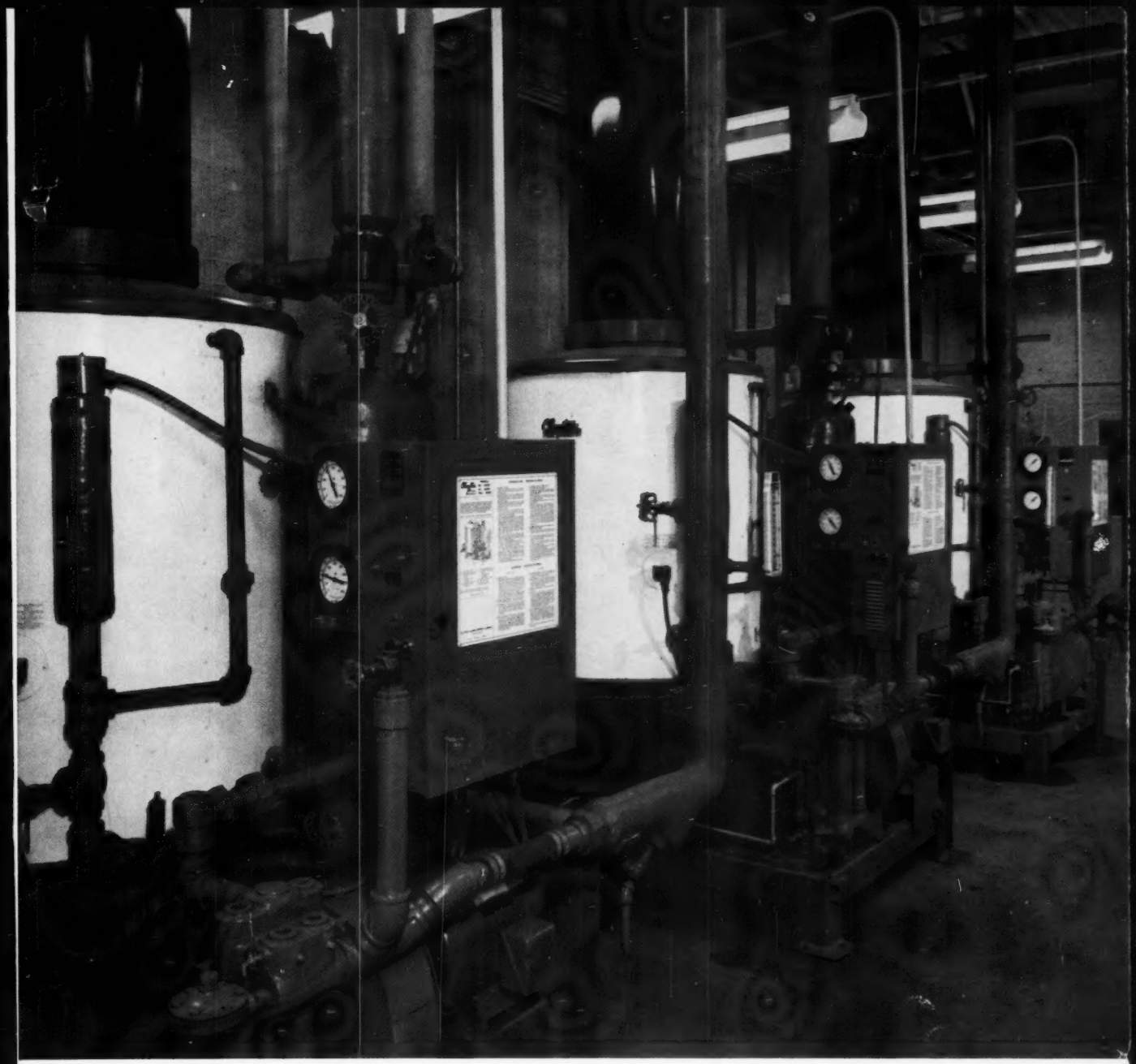
*Registered T.M. International Salt Company

BOSTON CHARLOTTE CINCINNATI NEWARK NEW YORK PITTSBURGH
BUFFALO CHICAGO DETROIT NEW ORLEANS PHILADELPHIA ST. LOUIS

INTERNATIONAL STERLING SALT SALT COMPANY

"A STEP AHEAD IN SALT TECHNOLOGY"

For more facts circle 329 on Reader Service card, p 99



MODERN STEAM—AS EFFICIENT AS IT LOOKS

Up to 18,000 lbs./hr. of high quality steam is produced by this Clayton Steam installation. Each unit requires only 4′ x 7′ floor space. This is the way a truly modern, efficient steam plant can and does look. This is compact. This is clean. This is Clayton. It happens to be the plant of Southwest Forest Industries, Phoenix, Arizona, U.S.A. It could be yours. Yours could be just as modern, just as economical of fuel and space, just as automatic, just as safe. Yours too, could save money with "steam on demand"—and save on time and labor. If your needs are for 500 to 65,000 lb./hr. or more... from 15 to 300 psi for processing and/or heating... you will gain when you go modern with Clayton.

Write for interesting model boiler room. Free. Please, on your letterhead. Graphically portrays the dramatic space-weight savings practical with Clayton in your own plant.

For more facts circle 202 on Reader Service card, p 99

Clayton

Sales and service in 88 countries

STEAM GENERATORS

CLAYTON MANUFACTURING COMPANY

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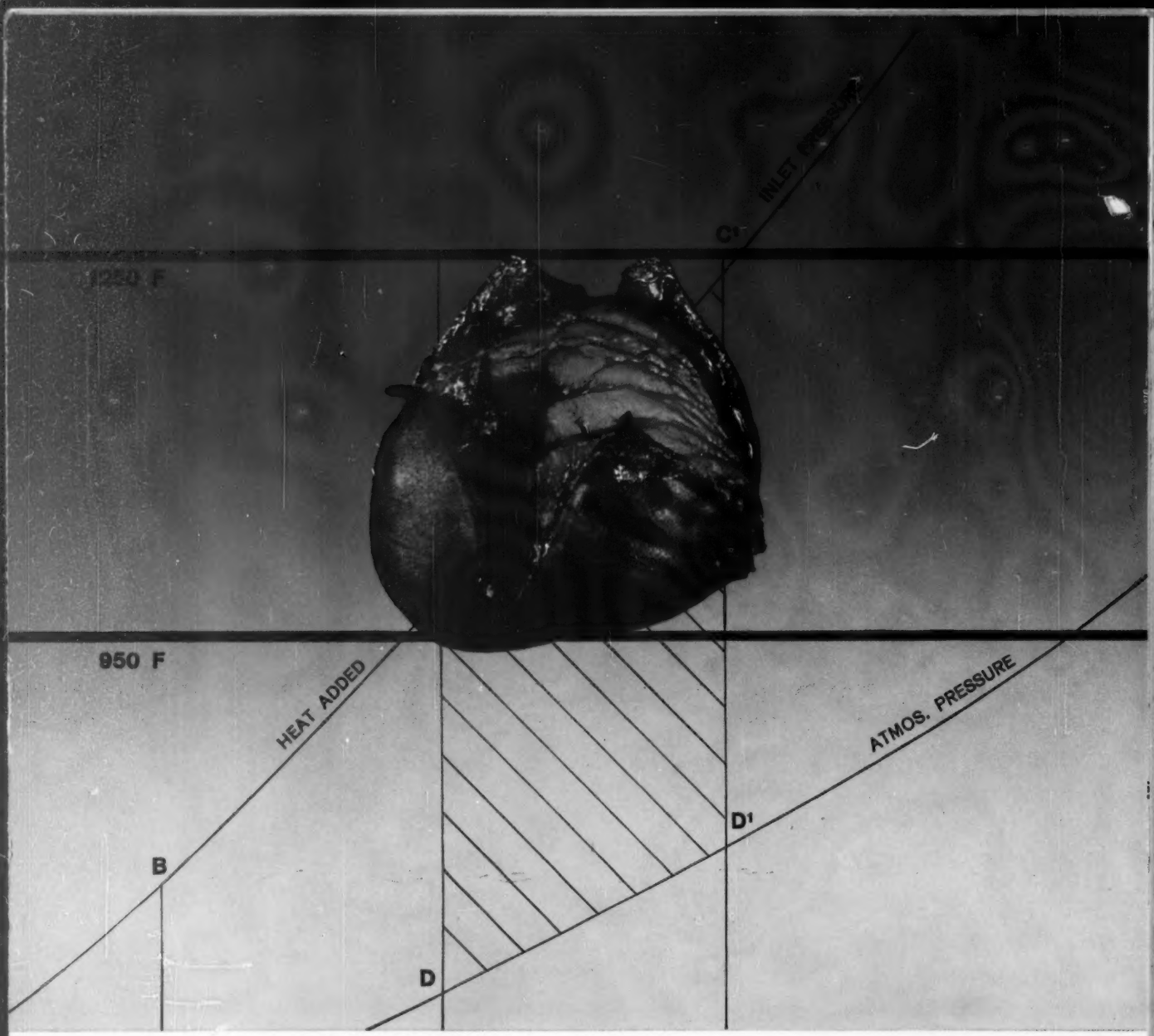

THE POWER RECOVERY "CHESTNUT"

or how to take power from 950F—1250F tail gas

A proven method for taking mechanical power from process tail gas below 950F is the turbine. Taking power from tail gas above this temperature has, in the past, been a power recovery "chestnut"—too hot to handle despite its desirability. But now, Worthington offers a Power Recovery turbine that can successfully pluck the meat from this very hot "chestnut."

The "meat" is extremely tasty. Frequently, if tail gas can be put to work at 1250F instead of 950F, as much as 12 to 15 per cent more power can be captured. In some installations, the heat exchangers that formerly handled the drop to 950F can be eliminated. In others, thermodynamic analysis will now show the feasibility of heating the gas to 1250F to get maximum mechanical power recovery.

In the past, use of Power Recovery turbines at the higher temperatures has been impractical. One major problem has been in mechanical design. Misalignment caused by excessive thermal expansion, higher temperature sealing, rotor construction, and forces imposed on the expander by inlet piping expansion and construction are all part of the problem. Today, Worthington has minimized them by creating a new design and using new materials.

A second major problem area that Worthington has overcome is analysis of the gas itself. Most tail gases are mixtures and their behavior is not fully plotted at the temperatures involved. But the behavior must be known before the turbine can be designed. Today, Worthington is ready to analyze the heat recovery potential of any gas or gas-steam mixture and to design a Power Recovery turbine to match.

If you would like to taste the meat of this power recovery chestnut, above or below 950F, write or call Worthington Corporation, Turbine Division, Dept. 48-14, Wellsville, N.Y.

WORTHINGTON

PRODUCTS THAT WORK FOR YOUR PROFIT

For more facts circle 203 on Reader Service card, p 99